Technical Report 66-8

Experimental Studies of Sensory Deprivation and Social Isolation

by

Thomas I. Myers, Donald B. Murphy, Seward Smith, and S. James Goffard

HumRRO Division No. 3 (Recruit Training)

June 1966

Prepared for:

Office, Chief of
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HumRRO

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
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DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT
WASHINGTON, D.C. 20310

CRD/J

SUBJECT: Experimental Studies of Sensory Deprivation and Social Isolation

TO:

1. This report concerns the psychological effects of four days in an environment of greatly reduced sensory stimuli and of social isolation on normal, healthy subjects.

2. Tests administered before, during, and after isolation indicated that prolonged confinement in a dark, quiet cubicle affects many aspects of behavior. The effects of such isolation appear to depend upon many conditions other than isolation per se.

3. The findings of this report are likely to be of interest to those concerned with performance in extreme or unusual environments or conditions, and may be relevant to military intelligence, operations personnel and medicine.

FOR THE CHIEF OF RESEARCH AND DEVELOPMENT:

1 Incl
Report

HERALD B. GALLINGER
Colonel, GS
Chief, Human Factors and
Operations Research Division

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The Human Resources Research Office is a nongovernmental agency of The George Washington University, operating under contract with the Department of the Army (DA 44-188-ARO-2). HumRRO's mission is to conduct research in the fields of training, motivation, and leadership.

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FOREWORD

This report is the final product of an extensive program of research undertaken by the Human Resources Research Office to evaluate experimentally the effects of sensory deprivation and social isolation upon a variety of human behaviors. The research was begun as Task ENDORSE, Effects of Controlled Isolation on Performance. It was subsequently transferred to HumRRO's basic research program, initially as Subtask PIONEER VI and subsequently as Basic Research Study 6.

The research was initiated at HumRRO Division No. 3 (Recruit Training) at the Presidio of Monterey, California while Dr. Francis H. Palmer was Director of Research. It continued under the directorship of Dr. Howard H. McFann and of Dr. John E. Taylor. Military support was provided by the U.S. Army Training Center Human Research Unit.

Because of its scope and the duration of the experimental work (1956-1962), an unusually large number of persons in addition to those reflected in authorship of this report made direct and substantial contributions to the program. In the earlier stages, Lyman M. Forbes, Jack A. Arbit, Jack Hicks, and Gerald Burday, and in the later stages, Edward J. Kandel, Robert D. McDonald, and Richard A. Monty worked on the development of the experimental techniques and the behavioral measures. Kenneth Anderson, Clifford Jones, Philip Berger, Elden Husted, Marshall Smith, Ray Bernardo, Robert Rappel, Robert Thayer, Donald F. Terry, George L. Hampton III, and James Turner assisted variously in the collection of the data. Benjamin J. Viljoen, Gordon Gay, and Paul M. Haas designed and constructed complex instrumentation and control systems for the isolation chambers. Carla Fritzsche, Judy Sylvester, Kay R. Khaliday, and Wayne L. Fox did most of the statistical analysis.

The research on which this report is based was designed and conducted by Dr. Thomas I. Myers, Dr. Donald B. Murphy, and Dr. Seward Smith in collaboration with the other contributors mentioned above. This report was prepared by Dr. S. James Goffard from more detailed and technical reports written earlier by various members of the research team.

HumRRO Research is conducted under Army Contract DA 44-188-ARO-2. The basic research studies are conducted under Army Project 2J014501B74B 02.

Previous publications under this research program are shown in the bibliography.

Meredith P. Crawford
Director
Human Resources Research Office

SUMMARY AND CONCLUSIONS

Research Problem

The primary stimulus to this research was a series of reports, issuing first from Hebb's laboratory and then from a number of others, which dealt with sensory deprivation and social isolation and some of their more startling and dramatic consequences. Exploration of these phenomena was of particular interest because of reports about American POWs in Korea who were reputedly subjected to similar conditions.

The goal set for this research was one of generating experimentally based conclusions about the effects of reduced sensory stimulation and controlled isolation upon the psychological functioning of human beings. The approach taken was to evaluate experimentally the effects of four days of dark, quiet isolation upon selected forms of behavior shown by normal, healthy young men.

Specifically, experiments were done to assess the individual's ability to think, solve problems, maintain vigilance, and maintain independence of judgment in the face of propaganda and group pressure. In addition, investigations were made of the experiences produced in the individual by isolation, on the effects of various forms of concurrent stimulation, and on the individual's subjective reactions to being in controlled isolation.

Research Procedure

This report is a comprehensive summary of the central findings of a series of studies that began in 1956. The initial series of pilot studies involved confinement of research personnel. In 1959, when it was certain that the method was safe, full-scale experimentation was begun. The experiments done assessed the effects of confinement in a dark, quiet environment on one set of individuals, as compared with the effects of a normal mode of life on other, similar individuals. Data were collected through June 1961.

The subjects in the studies were successive groups of enlisted men, to a total of 551, brought to the research laboratory just after they had completed Advanced Individual Training. They were above the Army average in intelligence and had been screened for physical and psychiatric deficiencies. They were shown the lightproof, soundproof cubicles that had been designed and constructed for these studies, and were introduced to the purposes and procedures of the experiment. Each one was then asked privately whether he wished to volunteer as a Cubicle subject. Of the 401 who did volunteer, 176, chosen at random, were assigned to cubicle treatment. An equal number, assigned to normal treatment, served as Control subjects.

Each Cubicle subject was confined in a dark, quiet cubicle (from which he could request release at any time) while the Control subjects and the nonvolunteers led a normal and only very slightly restricted life at the Presidio of Monterey.

Before volunteering, all subjects were given a large battery of psychological tests and measures. At various times during the isolation period, four experimental psychological tests or measures (in auditory form) were given all subjects. The nature of these during-isolation tests varied from time to time during the course of the research program. In addition, continuous measures were made of the activities of Cubicle subjects. When a Cubicle subject's isolation ended, either after the scheduled four days, or earlier if he requested, he and his corresponding Control subject were given another extensive battery of psychological tests and measures. The volunteers and nonvolunteers were compared on the pre-isolation tests, and the Cubicle and Control subjects were compared on the during-isolation and post-isolation tests. Comparisons were also made between long-staying and early release Cubicle subjects.

Results

About three-quarters of the subjects volunteered for the cubicle assignment. Those who volunteered tended to be younger and somewhat more venturesome and aggressive than those who did not. However, more than one-third of those who were assigned to cubicle treatment requested early release. These early release subjects reported isolation as being more unpleasant and stressful than did those who held out for the full time. They also showed more restlessness and disorientation in respect of time.

All Cubicle subjects reported the cubicle experience as being unpleasant. They found it produced boredom, disorientation in time, vivid spontaneous visual imagery, a blurring of the boundaries between sleep and wakefulness and between reality and unreality, as well as progressively increasing restlessness.

Experimental comparisons between Cubicle and Control subjects showed that:

(1) Although Cubicle subjects often reported spontaneous visual experiences during isolation, Control subjects reported equally frequent and equally vivid spontaneous visual experiences after a brief period in isolation and complete darkness.

(2) Cubicle subjects performed more poorly on complex mental tasks, but better on simple ones than did Control subjects.

(3) The less intelligent and comprehending Cubicle subjects were influenced by simple propaganda as well as by more subtle techniques.

(4) Cubicle subjects performed better on an auditory vigilance task than did Control subjects.

(5) Cubicle subjects showed a greater desire for structured or meaningful auditory stimulation, but were more annoyed by meaningless noise.

(6) Cubicle subjects showed a progressive increase in daytime restlessness.

(7) A high level of restlessness in a Cubicle subject tended to prelude a request for early release.

Conclusions

Four days of sensory deprivation and social isolation were found to produce the following effects:

(1) Subjective stress, severe boredom and restlessness, disorientation in time, blurring of the boundaries of sleep and reality, unrealistic fears, worry and anger, feelings of inability to concentrate and think, alterations of the body schema, and vague physical symptoms.

(2) Frequent and complex visual sensations. While these sensations do not increase in either frequency or intensity as isolation is prolonged, their effects are cumulative during lengthy waking periods in the dark, and they sometimes appear to be uncontrollable and freightening to subjects in isolation.

(3) Some impairment of intellectual functioning in more complex tasks, but also some facilitation in simple tasks (such as vigilance).

(4) Increased susceptibility to influence.

(5) A greater desire to hear information even when it is contrary to initial belief, and possible greater irritability or over-reactivity to mildly noxious stimuli.

(6) Progressive increases in restlessness superimposed upon clear-cut diurnal cycles of restlessness and of life-supporting activity.

(7) Subjects requesting early release found isolation more unpleasant and stressful and were more restless and disoriented in respect of time than those remaining the full four days.

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Chapter 1

THE RESEARCH APPROACH

RESEARCH PROBLEM

Only within the last decade has the study of human behavior in an unchanging sensory environment become a subject for study in the experimental laboratory. The dramatic findings of Hebb and his students came at a time of public concern over alleged changes in the behavior and even the loyalties of American prisoners of war in Korea. These investigators examined experimentally one deceptively innocent aspect of any confinement experience—the monotony of the surroundings.

For as long as they were willing, subjects in these experiments were paid to do nothing. Their job was to lie on a cot, wearing frosted translucent goggles and cardboard cuffs which extended beyond their fingertips, hearing nothing but the noise of a fan. They were made comfortable and were fed upon request. The effects of such a limited perceptual environment were startling. Subjects were surprisingly unwilling to remain in the experiment, experienced vivid and compelling visions or hallucinations, were impaired in intellectual and perceptual functioning, and were desirous of stimulation even in inane forms.[1]

Other studies followed,[2] many of them characterized by new ways of achieving isolation. Immersion in a tank of water,[3] a dark quiet room,[4] a tank respirator,[5] an anechoic dark room,[6] white noise and halved ping-pong balls over the eyes[7] have been among the techniques used in the earlier studies. Exploratory studies have probed human reactions to an impoverished environment, seeking clues to general hypotheses about human nature; correlational studies have examined the personal characteristics of individuals and their varying tolerances for sensory isolation, looking for predictive relationships; multiple-group controlled experiments have compared the modal reactions of sensorially deprived subjects to those of nondeprived subjects, seeking inferences about the effects of sensory impoverishment upon behavior. Few have produced experimentally based conclusions about the behavioral impact of sensory impoverishment.

The present research program by the Human Resources Research Office were therefore directed toward a systematic controlled experimental evaluation of behavior during isolation in a dark, quiet environment.

PLAN OF THE STUDY

The HumRRO program began at the Presidio of Monterey in 1956. In these experiments, a limited sensory and social environment was compared with a normal environment in terms of its effects upon a variety of human behaviors.

[1]Hebb *et al.*, **1;** Bexton, **2;** Heron *et al.*, **3;** Bexton *et al.*, **4;** Doane, **5, 6;** Hebb and Heron, **7;** Hebb **8.**
[2]Azima and Cramer, **9;** Azima and Cramer-Azima, **10, 11.**
[3]Lilly, **12, 13.**
[4]Vernon and Hoffman, **14;** Vernon and McGill, **15;** Myers *et al.*, **16.**
[5]Solomon *et al.*, **17;** Kubzansky, **18;** Leiderman *et al.*, **19;** Wexler *et al.*, **20;** Petrie *et al.*, **21.**
[6]Ruff and Levy, **22;** Levy *et al.*, **23.**
[7]Goldberger, **24;** Goldberger and Holt, **25;** Holt and Goldberger, **26.**

Pilot studies were performed to make certain that such research was safe and feasible. Eight virtually soundproof cubicles were then constructed and procedures developed for conducting the research. The large population of subjects, as well as the facilities and the necessary administrative manpower made available by the U.S. Army, made possible a project of unusually large scope. By the end of the study, more than 200 subjects had been isolated, a generous number in an area of research plagued by the magnitude of sheer effort required to collect sufficient data to yield stable findings.

PROCEDURE

The Independent Variable

The goal of the program was to generate reliable conclusions about the effects upon various forms of behavior of isolation, that is, of solitary confinement in an innocuously comfortable, dark, quiet environment. This required comparing the behavior of isolated subjects (the Cubicle subjects) with the behavior of subjects in a normal environment (the Control subjects). Dark, quiet isolation was chosen to minimize discomfort; such alternatives as wearing frosted goggles had been tried and rejected.

Emphasis was placed upon studying the behavior of the Cubicle subjects while they were still in isolation rather than as they emerged from isolation into a world of normally varied sights and sounds. The distinction is not absolute; measuring behavior during isolation necessarily entails some kind of intrusion. In these studies the only intrusions were the sounds of the test instructions and of the test stimuli. To minimize even such intrusions, however, only four brief auditory tests were given during the entire 96-hour isolation period—typically after 48, 72, 77, and 96 hours of isolation.

Since it was rarely possible to get measures of Control subjects' behavior in their normal environment that were comparable in any sense to the measures made on the Cubicle subjects, the Control subjects were returned to cubicle-like rooms in the laboratory for testing. They were usually tested in lighted test rooms to maximize the differences in sensory experience.

The independent variable was therefore defined not only by the contrasting environments experienced during the preceding hours or days by Cubicle and Control subjects, but also by differences in conditions and procedures during the measurement of the behavior under investigation. Thus, the independent variable was the total differential treatment which befell the subjects in the two groups.

Participation in the experiment was strictly voluntary. From the volunteers for the experiment, subjects were assigned at random to either cubicle treatment or control treatment. Those from the groups of subjects who did not volunteer were tested and treated like Control subjects, an arrangement which protected the privacy of each person's volunteering decision and also enabled comparisons between the volunteers and the nonvolunteers. The basic experimental comparisons, however, were based upon data from volunteers alone.

Briefly summarized, cubicle and control treatments were as follows:

Cubicle Treatment. Each Cubicle subject was continuously confined in a dark, quiet cubicle for a period of approximately 96 hours, unless he requested early release from the experiment. His solitude was broken only by an occasional during-isolation test. Certain conditions such as a special diet, loss of freedom to smoke, reduced activity, and social isolation were other obvious aspects of the physically comfortable but severely limited environment.

Control Treatment While the Cubicle subjects were in the cubicles for the 4-day period, the Control subjects lived essentially normal lives. They were housed in special quarters provided for them in an adjacent area of the Presidio, and supervised at all times by a noncommissioned officer assigned to the project.

Facilities

Eight lightproof and virtually soundproof cubicles, measuring 7 feet by 9 feet, were specially constructed for experimental isolation. The acoustical design of the cubicles[1] utilized a floating room-within-a-room construction with a septum wall. Designed to reduce external sounds to near threshold, these multiple-wall structures reduced the low frequency sounds from a nearby motor pool by 62 db. and the higher pitched sounds from adjacent passages and cubicles by 80 db.

Each cubicle was supplied with conditioned fresh air at 72° and was equipped with a foam rubber bed, a chemical toilet, and a refrigerator containing food and bottled water. The food was a sufficient supply of canned Rockefeller liquid diet to permit eating when desired, supplemented by saltines, graham crackers, sugar cubes, and salt. During confinement, Cubicle subjects wore loose pajamas; they were denied watches and smoking gear. A Lindsley manipulandum in the wall of each cubicle served as a response key for some tests.

Initially, conventional rooms with similar equipment were used for testing Control subjects. Later, four larger test rooms (about 10 by 11 feet) were constructed. These rooms were lightproof but less soundproof than the cubicles. Also acoustically designed, they attenuated sounds from the motor pool by 45 db. and those from the passages and adjacent rooms by 55 db. This was considered adequate for the test situations, which required neither intense sounds nor responses to near threshold stimulation. Like the cubicles, these rooms were well ventilated and contained a bed and the testing equipment, but no toilet or refrigerator.

Facilities for safety monitoring, test programing, and data collection were located in a large room nearby. An audio network connected the cubicles and the test rooms with this control center. This intercom system, along with tape recorders for playing instructions, was used in safety monitoring and data collection.

Subjects

The subjects were male enlisted personnel of the U.S. Army who had just completed Advanced Individual Training at Fort Ord, California. They were a high aptitude sample, selected at random from approximately the top 40% of the Army in intelligence as measured by the Army Classification Battery (i.e., General Technical (GT) Aptitude Area scores of 110 or higher). More than two-thirds of the sample had graduated from high school and approximately half had had at least some college education.

In age, they ranged from 17 to 27, with an average of 21. A bimodality in the age distribution, noticeable at 19 and 23, was due, in all likelihood, to the difference between the younger volunteers (RAs) and the older draftees (USs), who were equally represented in the total sample.

[1]Designed by Dr. Herman A. Medwin of the U.S. Naval Postgraduate School, Monterey, California.

In accordance with recommendations made by the Office of the Surgeon General, (a) medical and psychiatric clearance was obtained for all potential subjects, (b) only volunteers were used as Cubicle subjects, and (c) subjects were released from isolation upon request. This screened men with obvious physical ailments and those with psychiatric histories, and limited the findings on certain tests to subjects who remained in the cubicles long enough to take them.

The selective operation of these safety measures restricts the population to which the findings may be generalized. However, if the nonvolunteer and less persevering Cubicle subjects are assumed to have been individuals who would have shown even greater behavioral effects under sustained isolation, the findings can be seen to be conservative estimates of outcomes for an unrestricted population.

In a preliminary series of studies, January to November 1959, 227 men volunteered from a pool of 281 potential subjects and 95 of them were isolated for periods of up to six days. The findings of these studies will be reported only incidentally here.

Of the total of 551 potential subjects available for the experiments summarized in this report, 401 (73%) volunteered for isolation and 176 of them were actually isolated. Data were collected in 23 experimental runs, 16 between November 1959 and July 1960, and the remaining 7 between April and June, 1961. During the period between July 1960 and April 1961, runs were suspended while the moderately soundproof test rooms for Control subjects were being constructed.

Certain characteristics of the samples of subjects before and after the suspension period varied significantly. Those in the later runs were younger, had fewer years of schooling, and were more often Army enlistees (RA) than the subjects of the earlier period. These changes from one sample to the other seem not to have had serious consequences. There was (a) complete agreement between samples in the reasons stated for volunteering, for not volunteering, and for requesting early release, and (b) great consistency in the two samples in the results from such measures as the subjective stress scale and the retrospective questionnaire, which were administered to all subjects.

Classes of Tests

Three general classes of tests were given:

(1) Pre-isolation tests, given to all subjects prior to the beginning of the isolation period.

(2) During-isolation tests, given to all Cubicle subjects who had not requested early release, and to a like number of Control subjects.

(3) Post-isolation tests, given to all subjects at the end of the 96-hour isolation period, or sooner to Cubicle subjects requesting early release.

Experimental Run

The basic plan for each experimental run called for 24 potential subjects, of whom a random 8 (or half of the volunteers if there were fewer than 16) were to be assigned to cubicle treatment.

Medical and psychiatric screening of potential subjects took place at Fort Ord prior to their being made available to HumRRO. On the evening of their graduation from Advanced Individual Training, the 24 potential subjects were brought to the Presidio.

The next morning they were brought to the laboratory where the experiment was described to them in detail. They were told that volunteer subjects would be placed alone in dark, soundproof cubicles for a continuous period of 96 hours; that they would be monitored at all times over an intercom but that the monitor was not permitted to converse with them; that they would be free to move around within the cubicle, and that they might withdraw from the cubicle at any time if they found that they could not tolerate the situation. They were urged to weigh their decision about volunteering carefully, were told that it need never be known by others, and were urged not to volunteer unless they seriously intended to complete the full four days of isolation. They were then shown the cubicles and each man was placed in a separate cubicle for a private interview concerning whether or not he wished to volunteer. The remainder of the day was filled with pre-isolation testing.

On the following morning, half of the volunteers were chosen at random for Cubicle treatment and taken to a cubicle for a thorough review of the housekeeping facilities and procedures. Each man then went into his own cubicle and went to bed, and the light was turned out. Safety monitoring from the control room began, and continued 24 hours a day until the last man was brought out of his cubicle. During-isolation tests that involved talking, such as solving problems or reporting visual sensations, were tape recorded; tests that did not involve talking, such as reaction time, were presented and recorded automatically.

Meanwhile, the Control subjects were informed that they had not been chosen. Although confined to the Post for the duration of the experiment, they did have free access to the PX, the library, and the theater during their off-duty hours. During duty hours they were put on light work details. For the during-isolation tests, they were brought to the laboratory and tested on the same schedule as the Cubicle subjects.

At the end of 96 hours, the Cubicle subjects who were left were told that the time was up. The exit procedure was the same for all subjects, early release or long-staying. After their eyes were adapted to the light, and before they left the cubicle, they took some of the post-isolation tests. The corresponding Control subjects were also brought to the laboratory for the same post-isolation tests. After post-isolation testing, Cubicle subjects were given hot food and had a chance to shower and shave before they joined their fellow Cubicle subjects in a group interview.

At a final debriefing the following day, deferred questions were answered. The subjects then went on a 3-day pass.

PLAN OF THE REPORT

This report is a comprehensive summary of the major experiments but is limited to the more central findings. More detailed presentations of data can be found in a series of ancillary reports (marked with asterisks in the bibliography).

The research in this program fell into two stages. The first was an impact evaluation stage, designed to determine experimentally whether isolation was, in fact, stressful. The findings from this stage are given in the chapters on The Isolation Experience and Reported Visual Sensations.

The second stage extended the appraisal of effects of isolation to other kinds of behavior. The summaries of this stage are in the chapters on Post-Isolation Effects, Intellectual Efficiency, Vigilance and Alertness, Desire for Stimulation, Conformity to a Group Norm, Propaganda and Attitude Change, and Conditioning of Connotative Meaning.

Chapter 2

THE ISOLATION EXPERIENCE

This account of the more general characteristics of the isolation experience draws heavily upon post-isolation interviews with Cubicle subjects. It also includes, however, a number of specific measures, as, for example, measures of subjects' activities while in the cubicle, ratings made by Cubicle and Control subjects of the subjective stressfulness of their situations, and a variety of retrospective descriptions of the experience.

VOLUNTEERING

Even though, in the usual sense of the word, they profited very little by volunteering, about three-fourths of the potential subjects volunteered for the Cubicle experience. Subjects volunteered for a variety of reasons, most frequently saying that (a) they wanted to contribute to a scientific effort, or (b) they wanted to see how they would react. Very few attached any importance to implicit social pressures from the experimenters or from other subjects. Many looked upon isolation as a challenge to their ability to endure stress. Others said they wanted to use the time to think out personal problems or to plan for the future. Still others thought it would be a good time to catch up on their sleep after the rigors of Advanced Individual Training.

Many men who did not volunteer said they were afraid they could not last the full time and would thus fail the experimenters and themselves. Others said they disliked being in the dark for long periods, or they were too restless to do nothing for four days, or they questioned the palatability of the liquid diet.

Descriptive information about the subjects was obtained from the pre-isolation measures, which included background information about age, education, marital status, basis of Army duty (volunteer or draftee), integrity of home, size of family, order of birth, and smoking habits, as well as scores on the Minnesota Multiphasic Personality Inventory (MMPI), the Edwards Personal Preference Schedule (EPPS), the achievement scale of the Iowa Picture Inventory Test (IPIT), and, from the Army Classification Battery, the General Technical (GT) Aptitude Area score, used as a general intelligence measure throughout the research program, and the Classification Inventory (CI) test, an empirically derived measure predictive of potential performance under the severe stresses of infantry combat.

The differences between volunteers and nonvolunteers were separately analyzed for the two data periods (runs 1-16, Nov 59-Jul 60; runs 17-23, Apr-Jun 61). Results were not wholly consistent. On none of the variables did volunteers and nonvolunteers differ at or beyond the .05 level of significance in both data periods, although on some variables they differed in the same direction to varying extents. While it is quite possible that the observed differences were all products of random sampling, the pronounced shift already noted in certain of the characteristics of the sample (such as age and proportion of RA and US men) from one experimental period to the other may indicate a large shift

in the character of the population from which the samples were drawn. The experimental and other findings in the two periods, however, were quite congruent in terms of the differences between Cubicle subjects and Control subjects.

The overall distinguishing characteristics of the volunteers (Table 1) were therefore identified by combining the results from the two data periods (Mosteller and Bush, 27). (A tabulation of all of the differences is given in Appendix Table A-1.) In a population screened for psychological health and stability, the men who were willing to volunteer for isolation appear to be even sounder and more stable than the average.

Table 1

Variables on Which Volunteers Differed Significantly ($p<.10$) From Nonvolunteers

Variable	Higher Group	p
Age	Nonvolunteers	.05
Percent draftees	Nonvolunteers	.05
Combat aptitude (Army CI Scores)	Volunteers	.005
MMPI Scales		
D (Depression)	Nonvolunteers	.03
Hy (Hysteria)	Nonvolunteers	.09
Pd (Psychopathic deviate)	Nonvolunteers	.005
Pt (Psychasthenia)	Nonvolunteers	.08
EPPS Scores		
Change	Volunteers	.06
Aggression	Nonvolunteers	.01

THE CUBICLE EXPERIENCE

Most of the Cubicle subjects were pleased that they had been selected, but a number indicated concern over the anticipated stress, and, in fact, rated their subjective stress at the moment higher than did the Control subjects. The Control subjects presented a picture of mixed disappointment and relief. Many of them had made careful plans for the isolation period and felt let down; at the same time, they had felt some concern about how they would react, a concern relieved by their selection as Control subjects.

Although many of the Cubicle subjects had asked if they might talk and describe their experiences, most of them talked surprisingly little during isolation. When they were asked about this later, many said that they felt foolish carrying on a one-way conversation, or that they were reluctant to talk even about innocuous details. Others said that they did not want to reveal too much about themselves.

The subjects spent almost all of their time on the bed. Although almost all of them commented on their boredom and the slow passage of time, relatively few actually carried out their plans to help pass the time in physical activity. They reported that they had great difficulty carrying plans into action, although they fidgeted, squirmed, and experienced considerable restlessness.

Microswitches signaled whenever a subject left the bed, went to the refrigerator, or used the toilet, and a movement detector wired to the bed springs measured his restlessness. His gross bodily activity was thus measured continuously and recorded automatically every ten minutes throughout the entire 96 hours.

Because of difficulties with instrumentation, complete records were available only during the last few runs. Samples of data were taken from these records in blocks of six hours each, the blocks from 1100 to 1700 hours on each of the four days to estimate daytime activity and the four blocks from 2300 to 0500 hours to estimate nighttime activity. An index of restlessness (the total number of movements detected during a 6-hour period divided by the total number of minutes the subject was on the bed during the same period) indicated approximately the number of gross bodily movements made by the subject per minute. This index correlated quite highly with the amount of time spent off the bed ($r = .66$). Although time off the bed was correlated with the exercise of biological maintenance activities ($r = .60$), the latter was correlated only .18 with restlessness.

Figure 1 presents a mean restlessness index for the "day" and the "night" time blocks for each of the four days for 23 subjects on whom complete data were available. Statistical analysis affirmed the evidence of both greater restlessness during the daytime hours ($p < .005$) and an increasing buildup of daytime restlessness as isolation continued ($p < .001$).

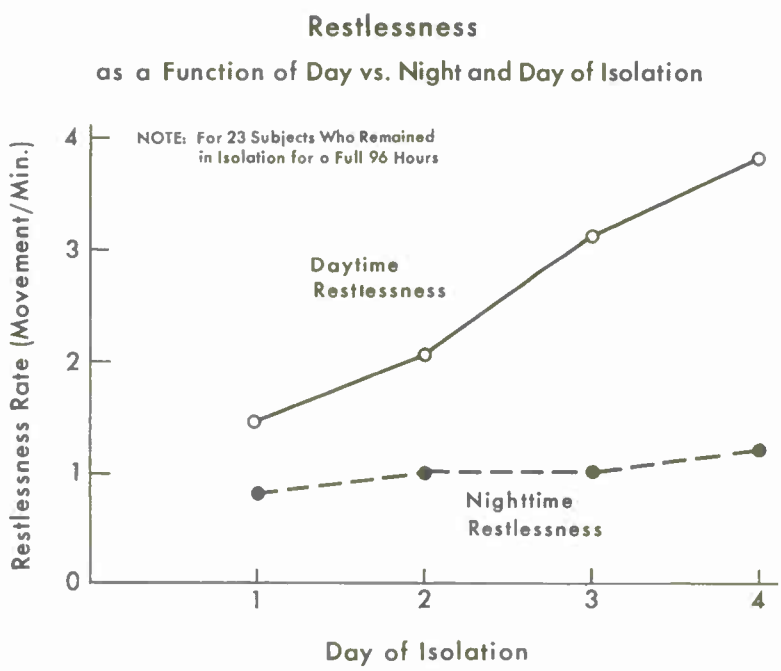

Figure 1

Life-sustaining activities (eating, drinking, etc.) were examined in the same way, taking the four time blocks from 1200 to 1800 hours for daytime activities and the four from 2400 to 0600 hours for nighttime activities. One point was tallied if the subject took any food or drank any water or used the toilet during the 6-hour period, two points if he did any two and three if he did all three, and no points if he did none of them.

Figure 2 shows a mean activities score for each of the daytime and nighttime blocks for 29 subjects on whom complete data were available. Statistical analysis indicated that the pattern of more activities during the day and fewer

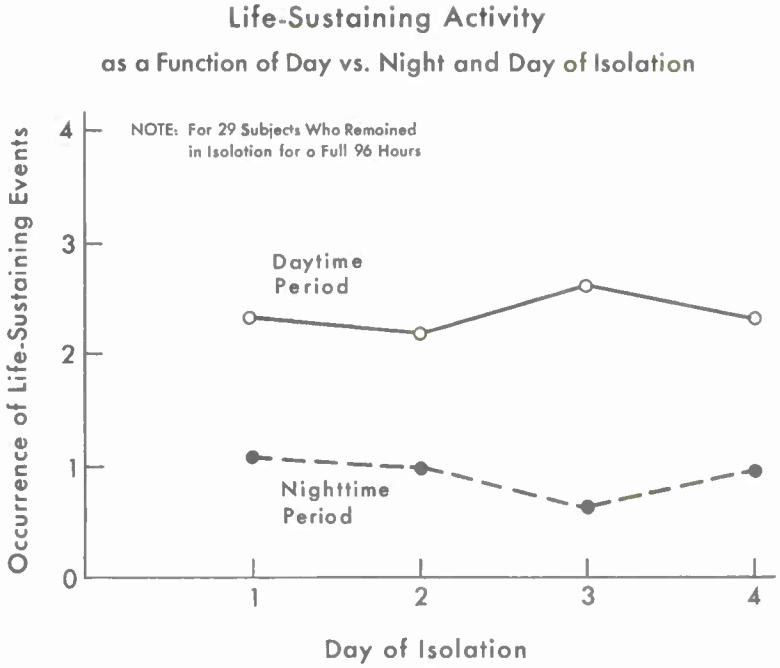

Figure 2

at night was persistent with little variation ($p < .001$). The perseveration of diurnal cycles during cubicle confinement contrasts markedly with the retrospective accounts of Cubicle subjects that their normal activities such as eating and sleeping became disrupted, particularly near the end of the isolation period. The increase in daytime restlessness agrees more with their reports of greater fidgeting and restlessness toward the later stages of isolation.

The subjects reported that they spent a great deal of their time in the cubicles thinking and dreaming about the past. For some these memories and dreams were pleasant and helped to pass the time; many however, found that unpleasant, frightening, and strange thoughts occupied these periods and, worse, that they were unable to stop these thoughts. Some subjects became fearful that something terrible might happen to them, or that they might be adversely affected by the experience; others were bothered because they could clearly picture in front of them the things they were thinking about. Still others reported being unable to distinguish wakefulness from sleep, feeling that the room was closing in on them, or feeling that their bodies were different from normal. Some subjects were convinced that pictures had been flashed on the walls of the cubicles, and others reported that they thought someone was hiding in the room.

Curiously enough, very few subjects reported that they missed smoking, even though many of them had been concerned about this before entering the cubicles. The absence of normal cues in the singular cubicle environment appears to account for this.

Cubicle subjects ate less food than they wanted, but not necessarily because it was unpalatable. Often they simply did not want to eat even when they felt hungry. Consequently, they showed an average weight loss of 4.5 pounds, in contrast to the Control subjects, whose average weight increased slightly ($p < .001$). The long-staying Cubicle subjects lost more weight ($p < .001$) than the early

release subjects, although there was no association between rate of food consumption and length of time spent in the cubicles. Although weight loss was inversely related to rate of food consumption ($r = -.59$, $p < .001$), neither variable was found to be related to subjects' perception of hunger. Thus, the weight loss was a product of eating rate and time spent in cubicles, but was quite separate from verbalized feelings of hunger.

Subjects found themselves hard-pressed to describe accurately what the cubicle experience was like, and to explain why four days lying on a foam rubber mattress in an air-conditioned room should be difficult. The sheer absence of the customary markers of externally organized time, of course, left only a stream of subjective experience difficult to sort out and remember in temporal sequence.

That isolation was difficult or unpleasant shows in the fact that seven out of every eight Control subjects, but only half of the Cubicle subjects, were willing to volunteer for a hypothetical second term ($p < .001$). Even with no enthusiasm for further experimental participation, most long-staying Cubicle subjects felt pleased at having successfully completed a difficult task.

RETROSPECTIVE EVALUATIONS

Three standard procedures were used to collect retrospective evaluations: a stress rating scale, a questionnaire, and a mood scale.

Subjective Stress Scale (SSS). This scale, developed for Task FIGHTER (Berkun et al., 28), consists of 15 words or phrases descriptive of feelings of stress, each with an empirically derived scale score (Kerle and Bialek, 29). The subject is asked to circle the one word or phrase that best describes how he felt at a given time. The words and their scale values are:

Word	Scale Value	Word	Scale Value	Word	Scale Value
Wonderful	00	Indifferent	48	Unsafe	76
Fine	09	Timid	57	Frightened	83
Comfortable	17	Unsteady	64	Terrible	87
Steady	27	Nervous	69	In agony	92
Didn't bother me	40	Worried	74	Scared stiff	94

The SSS was administered to both Cubicle and Control subjects approximately one hour after the termination of the experiment. Ratings were obtained from each subject with respect to how he felt (1) pre-isolation, before he knew he was coming to the Presidio of Monterey for a week, (2) during-isolation, while he was in the cubicle, (or living at the Presidio), and (3) post-isolation, right now.

The mean SSS scores are presented in Table 2. Clearly, subjective stress in the Cubicle subjects was highest while they were confined and dropped after their release, while subjective stress in the Control subjects declined almost continuously.

Table 2

Mean Subjective Stress Scale Scores in Pre-Isolation, During-Isolation, and Post-Isolation Phases[a]

Data Period	*N*	Pre-Isolation	During-Isolation	Post-Isolation
First (runs 1-16)				
Cubicle subjects	116	28.2	50.0	28.9
Control subjects	118	34.3	24.4	19.6
Second (runs 17-23)				
Cubicle subjects	56	30.6	52.1	42.9
Control subjects	82	22.5	23.7	20.6

[a]Higher scores indicate greater stressfulness.

Retrospective Questionnaire. Shortly after the end of the isolation period all subjects were given a questionnaire designed, on the basis of personal experiences and interviews, to tap retrospectively a variety of feelings and reactions. The items were so stated as to be equally applicable to Cubicle and Control conditions.

The following 23 areas were covered:

Area and Sample Item	Number of Items
Reported visual sensations—"In the dark I was annoyed by bright flashes or a bright flickering in my eyes."	16
Dreams—"I had dreams which were strikingly vivid."	11
Reminiscence and memory—"I had an unusually clear memory of events in my past."	5
Sex—"I was overwhelmed by thoughts about sex."	5
Novelty and surprise—"I had surprising daydreams or fantasies."	6
Speech difficulties—"I could only speak in a halting way."	4
Army assignment—"I wondered about my next assignment."	3
Self-appraisal—"I thought about myself in a way that is unusual to me."	5
Inefficiencies of thought—"I found it difficult to remember clearly what I was thinking about only a short time earlier."	26
Loss of touch with reality—"My surroundings seemed changed although I knew they weren't."	9
Attitude toward monitor and tests—"The sound of the monitor's voice pleased me."	5
Religion—"I thought about religion and religious matters."	4
Lonesomeness—"I had thoughts about how unpleasant it was to be completely alone for some time."	4
Hunger—"I felt a desire for some particular kind of food."	8
Tedium of time passage—"Time passed slowly."	5
Temporal orientation—"I became upset because I could not tell what time it was."	4
Subjective restlessness—"I felt restlessness."	5
Restless acts—"I became aware that I was tapping my fingers."	3
Anger—"I felt like fighting someone."	6
Regret participation—"I regretted having volunteered for this experiment."	5
Worry and fright—"I worried beyond reason about something that did not really matter."	29
Feelings of well being—"I felt comfortable and satisfied."	7
Body image change—"I felt as though some part of my body had changed in size."	5

Subjects indicated whether each statement applied "not at all," "somewhat or slightly," or "mostly or generally" to life during the isolation period. The responses to each item were then dichotomized as nearly as possible at the median and assigned scores of 0 or 1. Scores in specific content areas were obtained simply by summing these scores on the items covering that content.

Since the results from the two data periods were very similar, they were combined. A complete tabulation of the findings can be found in Appendix Table B-1. In brief, Cubicle subjects were restless and fidgety, lonely, and obsessed by tedium and loss of time orientation. They were plagued by worries and frights they sometimes recognized as irrational, and they experienced fewer positive thoughts and feelings. They became angry, fed-up, and regretted having volunteered to participate in the experiment. Dreams and memories were strikingly vivid and the boundaries between the two became indistinct. Visual sensations were reported that seemed real, and changes were sensed in body image and in the surroundings. Thoughts seemed especially personal, and many topics and concerns of daily life seemed remote. Such thoughts and feelings were less frequent among the Control subjects, although their incidence was not zero.

Adjective Checklist Mood Score. A third technique was based on a list of 114 adjectives referring to feeling states of the individual, each to be categorized by the subject as applying to him "not at all," "somewhat or slightly," or "mostly or generally." In a pilot study each of the adjectives had been rated for its social

desirability when applied to a member of one's peer group. Sixty-two of the adjectives such as energetic, happy, inspired, and efficient were given positive ratings, while 52 others such as jittery, careless, uncertain, and miserable were given negative ratings.

Two hours after the end of isolation, all subjects were instructed to respond three times to each adjective: as it applied now, as it applied during isolation, and as it applied before coming to the Presidio. Responses to the positive items (when "mostly or generally" was scored as 1 and all other responses as 0) gave "high" and "low" groups of approximately equal size for each item. Responses to the negative items (when with "not at all" was scored as 0 and all other responses as 1) gave similar results. These scores combined (according to the formula, "positive score minus negative score plus 52") gave a composite "mood" score greater than zero for each subject for each of the three points in time, with a high score reflecting a positive image and a low score a negative or unfavorable image.

The mood score means (Table 3) demonstrate clearly that during isolation the mood of the Cubicle subjects was more negative than the mood of the Control subjects and that this difference persisted into the post-isolation period. The pre-isolation differences were consistently much smaller than either of the others. These findings are quite consistent with those from the Subjective Stress Scale and the retrospective questionnaire.

Table 3

Mood Score Means in the Pre-Isolation, During-Isolation, and Post-Isolation Phases

Data Period	*N*	Pre-Isolation			During-Isolation			Post-Isolation		
		M	*t*	*p*	*M*	*t*	*p*	*M*	*t*	*p*
First (runs 1-16)										
Cubicle subjects	107	61.1	2.01	<.05	38.5	9.15	<.01	51.9	4.54	<.01
Control subjects	112	65.7			58.6			62.7		
Second (runs 17-23)										
Cubicle subjects	50	60.5	0.68	>.20	36.5	6.83	<.01	49.5	2.32	<.05
Control subjects	78	62.8			55.8			56.8		

THE ROLE OF EXPECTANCY AND COMPLIANCE

While the items which have been described did not sample all possible feelings and reactions that might be relevant, the consistency of the outcomes suggested that, motivated to "help" the experimenters, the subjects might have wittingly or unwittingly exaggerated their descriptions of life during the experiment, in a fashion such as Orne has discussed (30). There was little evidence for a common general factor, such as acquiescence, underlying the scores in the 23 content areas of the questionnaire. The median correlation among the 23 area scores was only .20 for the Cubicle subjects, and .24 for the Control subjects. Yet it was still possible that the responses of either group of subjects might have been affected by sets that would accentuate the differences between them.

One study was done to find out how well subjects could predict the experimental outcomes, without actually undergoing four days of isolation. An independent group of 120 subjects was used, similar in age, intelligence, and so on,

to the original experimental subjects. These subjects spent 30 minutes in the cubicles. They were given a description of the isolation condition and asked to judge whether, in an imagined 4-day period of isolation, each questionnaire item (. . . Time passed slowly; I felt restless . . .) would apply with greater than normal, about normal, or less than normal frequency. Each of these judgments was then scored 2, 1, or 0 respectively; by simple averaging, a mean expectation score was derived for each subject on each of the 23 content areas. Overall analysis showed significant variation among the mean expectation scores in the various content areas.

A detailed analysis showed that 5 of the areas were predicted to be of significantly greater-than-normal concern for Cubicle subjects, 10 to be about normal, and 9 to be of significantly less-than-normal concern.

These predictions were then compared with the observed results. When the 20 areas where the Cubicle means significantly exceeded the Control means were considered areas of greater-than-normal concern, the 2 where the means were not different, of normal concern, and the 1 where the Control means exceeded the Cubicle mean, of less-than-normal concern, the predicted and the observed outcomes did not correspond very closely. The judges predicted the correct level of concern in only 5 of the 23 areas, while in 8 the prediction was flatly contradicted by observation.

The same group of judges did make reasonably accurate predictions, however, when, under the same instructions, they filled out the adjective checklist. Although they underestimated the pre-isolation mood of the Cubicle subjects (predicted 51.4, observed 60.9) they came quite close to the during-isolation level (predicted 35.6, observed 37.8). Clearly, in filling out the checklist, they anticipated correctly that cubicle life would have fewer pleasant or positive aspects than normal life.

Simple set effects evidently can not account for the specific differences observed between Cubicle and Control subjects on the retrospective measures although they might have influenced somewhat the more global and general responses.

THE EARLY RELEASE CUBICLE SUBJECT

More than one-third of the Cubicle subjects requested early release. Of the 65 (37%) who withdrew prematurely, 10 sought exit within the first 24 hours, 17 during the second, 24 during the third, and 14 during the fourth day of the isolation period. The number withdrawing during the second and third days was disproportionately large ($\chi^2 = 6.43$, $df = 3$, $p < .10$). Since the during-isolation tests began only at the end of 48 hours of isolation, there was no obvious relationship between testing events and withdrawal.

These men were apparently in considerable conflict before they asked for release, and felt chagrin and guilt about doing so. Most of their reasons for withdrawing centered upon tedium, boredom, and restlessness. Almost all of them complained that they couldn't sleep any more, and couldn't stand the boredom, and that they had become very restless and fidgety. They felt that time passed much more slowly than they thought it would, and were bothered that they could not tell how much time they had left to serve. They reported a variety of physical symptoms, such as tenseness, sore back muscles, and headaches. Some reported that the darkness or the silence became severely oppressive, and others noted that they ran out of things to think about, or that they could not keep certain thoughts out of their minds, or that their thinking became jumbled and difficult. Some even expressed surprise when the experimenter arrived at the cubicle to

start the exit procedure, claiming that their requests for release must have come while they were talking in their sleep. The fact that quite a number sought to reverse their decision after announcing it highlights the conflict in their motives.

The SSS scores of early release and long-staying Cubicle subjects in both data periods showed the pre-isolation level of stress to be substantially the same for the two groups. During isolation, however, the early release subjects felt much more stress than did the long-staying subjects, although during-isolation stress was significantly greater than pre-isolation stress for both. The early release subjects also rated their post-isolation stress higher than did the long-staying subjects.

Scores on the retrospective questionnaire indicated that early release subjects experienced greater lonesomeness, tedium of time passage and temporal disorientation, subjective restlessness, vividness of reminiscence and memory, and inefficiencies of thought, and had fewer feelings of well-being than did the long-staying Cubicle subjects. These comparisons are summarized in Appendix Table B-2.

The mean mood scores of the early-release and long-staying subjects differed only in the second data period, when the early release subjects painted a much more negative picture of themselves during and after isolation.

In summary then, early release Cubicle subjects complained more of boredom, restlessness, tedium, and temporal disorientation while they were in the cubicles than did long-staying Cubicle subjects. They made higher ratings of their subjective stress both during and post-isolation, reported having more intense experience of lonesomeness, subjective restlessness, inefficiency of thought, worry, and fright. They had fewer feelings of well-being in the cubicles, and within one experimental period at least, they reported a more negative general mood during and just after isolation.

PREDICTION OF EARLY RELEASE

It is obvious that bias is introduced into the final Cubicle-Control comparisons by allowing Cubicle subjects to withdraw at will. Even the matching of residual experimental subjects with members of a large pool of Control subjects on the basis of pretest scores cannot ensure their being matched on all other variables of potential significance (Zubek et al., 31). Closing the option to withdraw is not only impracticable but could be expected to produce biases of its own. Since early-release Cubicle subjects were more affected by isolation than their long-staying colleagues, their responses on the various criterion measures can be reasonably expected to be more deviant than the responses of the long-staying subjects. Estimates of the effects of isolation will therefore be conservative and underestimate the effects that would be observed in unselected samples. Predictors based on such truncated samples can be expected to be more effective with unselected samples.

Two types of data were collected to predict requests for early release. In the second experimental period, measures were obtained quite early during isolation on two behaviors identified earlier as closely related to subjects' requests for early release, disorientation in time and restlessness.

Time Orientation. The time orientation test consisted simply of asking the Cubicle subjects to estimate the day and time of day at four different points during the 96-hour confinement periods. This was done after 4, 45, 84, and 94 hours without the subjects' knowing in advance that they would be asked to estimate the passage of time.

Since some of the subjects requested release before the second time-orientation test at 45 hours, only the data from the first (4-hour) test could be used. On that test the early release group showed an average error of 3.72 hours, estimating that almost twice as much time had elapsed as in fact had. The long-staying group showed an average error of 1.13 hours, also in the direction of overestimation. The difference between the two groups was significant ($p < .025$). Within the early release group, the correlation between this error and the duration of their confinement was $-.43$ ($p < .05$); subjects who made larger errors tended to stay in isolation a relatively shorter time.

Restlessness. As noted earlier, Cubicle subjects showed progressively increasing restlessness over the four days of isolation, with daytime restlessness being greater and increasing faster than nighttime restlessness. The monitors became convinced that they could tell in advance from an audible increase in a man's restlessness that he was likely to request early release. During Day 1, early release and long-staying subjects did not differ in restlessness, because virtually all subjects slept a great deal. On Day 2, however, subjects who eventually requested carly release showed significantly greater daytime restlessness. Further evidence of an inverse relationship between restlessness and endurance within the early release group appears in the correlation of $-.62$ ($p < .02$) between restlessness on Day 2 and time until request for early release. Even among the early release subjects the more restless tended to withdraw sooner from the cubicles. These behavioral measures thus parallel the findings from the questionnaires that early release subjects experienced more intense feelings of restlessness, tedium, and disorientation in time.

Biographical Correlates of Endurance. Overall, the early release subjects were younger, higher on the Psychopathic Deviance and Hypomanic scales of the MMPI, lower in need for Deference and Affiliation and more likely to be classed as smokers than the long-staying subjects. (See Appendix Table A-2).

SUMMARY OF THE ISOLATION EXPERIENCE

Roughly three-quarters of the men assigned to the experiment volunteered for isolation, to "contribute to science" or to "test one's self." The one-quarter who chose not to volunteer did so for reasons that are less easily classifiable. The volunteers were somewhat younger, more highly endowed in combat aptitude, and generally lower in Depression, Psychopathic Deviancy, and possibly Hysteria and Psychasthenia on the MMPI. They seem to represent a healthier and emotionally more stable sample of thc original population.

Restlessness and life-sustaining activities within the cubicles showed clear diurnal cycles, although the subjects themselves generally reported a breakdown of such regularity. Thc progressive increase observed in restlessness from one daytime period to the next was, however, mirrored by the subjective reports of the Cubicle subjects.

Scores on the Subjective Stress Scale, mood scores, and responses on a number of the areas of thc retrospcctive questionnaire showed that the Cubicle subjects found the experience stressful and productive of an unpleasant mood, both during and immediately following isolation. They also reported more spontaneous visual sensations, vivid dreams and memories, inefficiency of thought, blurring of the sense of reality, lonesomeness, tedium, restlessness, anger, worry and fright, and disturbance of body image, as well as fewer feelings of well-being.

Since outcomes anticipated by subjects not actually confined to cubicles did not correspond with outcomes actually obtained, it is clear that the findings from isolation could not have been the product of genuine but excessive cooperation aimed at "helping" achieve the "desired" outcomes.

Cubicle subjects who withdrew early attributed greater stressfulness and a somewhat less pleasant mood to the isolation experience than did the long-staying Cubicle subjects. They also placed a greater emphasis upon inefficiency of thought, loss of touch with reality, loneliness, tedium, restlessness, worry, and lack of positive feelings. The more a man overestimated the time lapse after four hours in the cubicle the more likely he was to ask for release—and the sooner as well. Similarly, the more restless a Cubicle subject was, the more likely he was to seek early exit, and the greater his fidgetiness the earlier would come his request. The early release Cubicle subject tended to be younger and a smoker, with somewhat higher scores on Psychopathic Deviancy and Hypomania, and lower scores on need for Deference. Tolerance for sensory isolation may be more characteristic of persons who tend generally to accept responsibility and who do not have the high energy level connoted by hypomania and perhaps by smoking.

Chapter 3

POST-ISOLATION EFFECTS

After 96 hours of completely dark and quiet isolation, Cubicle subjects found even ordinary visual objects rich in detail and highly saturated in hue and their auditory world more crowded with sounds than they had anticipated. Sights and sounds that would normally have served as the sensory background to more significant events acquired unusual power to attract their attention.

They also felt lightheaded, unsteady on their feet, a bit dizzy, even weak, although perhaps no more so than after prolonged bed rest in less restrictive surroundings. Some felt excited and were quite garrulous, but more soon felt surprisingly fatigued and spent much of the first day or so taking it easy. For many, complete recovery of eye-hand coordination and timing in speech took several hours.

The more agitated early release subjects reported relatively rapid subsidence of their feelings of anxiety. Only one or two subjects reported emotional tenseness or apprehension that lingered as long as the following day. However, during the first 24 hours, some subjects found themselves irritated by the loudness of sounds, had difficulty carrying on social conversation, and, although they wanted companionship, also sought periods of solitude. For some, sleeping and eating habits were also mildly disorganized.

Although the isolation experience itself was vivid and unusual, the memory of its distinctive characteristics was very quickly blurred by the flux of events in a normal environment. Clear recall of life in the cubicle seems to have been rendered difficult by the sheer paucity of cues common to both that episode and a normal environment. Much later, however, memories of the episode were revived in one subject beset by insomnia and in another engaged in testing food products reminiscent of the cubicle diet.

Since subjects in exploratory runs did not find that the post-isolation perceptual world was as dramatically altered as had been reported in earlier studies (surfaces did not appear warped nor were there major or striking changes in perceptual constancies), only two series of studies were done of post-isolation phenomena. One was concerned with the safety of isolation as an experimental procedure and with the validity of post-isolation test data. A second explored differential post-isolation effects of experimental and control treatments upon word meanings, word associations, simple mechanical coordination, and reading comprehension.

THE SAFETY OF ISOLATION

Feelings of well-being or "adjustment" were obtained from several tests. The Taylor Manifest Anxiety Scale (MAS), given the day before confinement and again after isolation, showed no evidence of any effect of isolation upon manifest anxiety. On the Harrower Group Rorschach, common responses were given more often on the post-isolation than on the pre-isolation administration ($p < .001$),

and more often by Cubicle than by Control subjects ($p < .05$). However, isolation had no effect that could be differentiated from test-retest effect. Scores on the three "validity" scales of the MMPI—L, F, and K—gave no evidence of change in test-taking motivation or ability among the Cubicle subjects.

OTHER BEHAVIORAL EFFECTS

Word Meaning. Before and after isolation, Cubicle and Control subjects rated 16 concepts, chosen as most likely to be affected by the isolation experience, on nine scales from the Semantic Differential (Osgood, 32). The concepts were companionship, boredom, isolation, darkness, aggression, self-control, volunteer, thinking, experiment, activity, sleep, failure, fear, sex, phantasy, and me.

The isolation experience had little impact on the meanings of these concepts, as measured along the evaluative dimension of the Semantic Differential. After isolation the Cubicle subjects made less positive evaluations of only three concepts—self-control, isolation, and darkness, a finding more suggestive than definitive.

Written Word Association. Four "negative" words—isolation, alone, time, and imagination—were matched in respect of frequency of usage (Thorndike and Lorge, 33) with four "neutral" words—cartoon, summer, low, and birthday. Subjects were given 60 seconds to record their associations to each word before isolation and within three hours after isolation. A reliable post-isolation difference ($p < .025$) showed the productivity of the Cubicle subjects to be somewhat depressed after isolation, and slightly more to the negative than to the neutral words ($p < .10$). In addition, the general productivity of early release Cubicle subjects tended to be more depressed than that of long-staying Cubicle subjects ($p < .10$).

Oral Word Association. It is not clear whether isolation reduces the fluency of association or the subjects' motivation to take tests or just their visual-motor coordination.

An oral word association test, using the same eight stimulus words, and again allowing a response period of 60 seconds per word was given before isolation and after approximately 76 hours of isolation. Since this test did not show a differential depression of free associational fluency, the findings on the written test were presumably a product either of altered test-taking motivation or of impaired visuo-motor coordination.

Mechanical Ability. In earlier studies of isolation, a post-isolation decline found on the digit-symbol substitution subtest of the Wechsler Adult Intelligence Scale and on block arrangement tasks,[1] as well as smaller and less consistent decrements in such tasks as anagrams and mental arithmetic, were attributed to intellectual impairment. In the same series of experiments, however, post-isolation impairment was also found in mirror drawing, handwriting, and tests of perceptual organization. There are other reports of post-isolation perceptual-motor disorientation on such tasks as pursuit rotor, rail walking, and the like (Vernon et al., 35).

The MacQuarrie Test (MacQuarrie, 36) of Mechanical Skills was given two hours after isolation to 32 Cubicle and 47 Control subjects. This test consists of seven subtests, each with its own instructions and timing procedures: Tracing, Tapping, Dotting, Copying, Location, Blocks, and Pursuit. The seven separate

[1]Bexton, 2; Bexton *et al.*, 4; Davis *et al.*, 34; and Solomon *et al.*, 17.

subtest scores and the total test score described in the test manual were used in this study. As can be seen from Table 4, the Control subjects outperformed the Cubicle subjects significantly on five of the seven subtests.

Table 4

Mean Scores of Cubicle and Control Subjects on MacQuarrie Test of Mechanical Ability

Subtest	Subjects[a]		p
	Cubicle	Control	
Tracing	33.4	38.0	.05
Tapping	37.8	39.7	
Dotting	17.4	20.0	.001
Copying	31.6	42.4	.001
Location	23.7	26.7	.05
Blocks	16.0	16.3	
Pursuit	19.9	24.5	.005
Total	59.7	69.3	.001

[a]The means are based upon *N*s that varied slightly because subjects occasionally misunderstood instructions.

The Control subjects had the higher mean score on the Army Clerical Speed (ACS) test which all subjects took before isolation. This test is moderately correlated with total score on the MacQuarrie Test ($r = .43$ for Cubicle subjects; $r = .46$ for Control subjects). Even after correction for this initial difference in clerical skill, the MacQuarrie scores of the Cubicle subjects were somewhat lower.

Insofar as the MacQuarrie Test does measure mechanical ability relatively incontaminated by intellectural factors, the eye-hand coordinations of Cubicle subjects are somewhat and significantly poorer after isolation than those of Control subjects. At least some of the intellectual decrement reported following isolation may thus be attributable to perceptual-motor disfunction. In this study, skill at processing symbols, associated with intelligence, has not been shown to be affected by isolation.

Reading Comprehension. The comprehension section of the Nelson-Denny Reading Test, given within three hours after isolation to 52 Cubicle subjects and 53 Control subjects, showed that isolation does impair the reading comprehension of Cubicle subjects ($p < .025$).

SUMMARY OF POST-ISOLATION EFFECTS

No differential change was found after isolation in the level of manifest anxiety (Taylor MAS), in the number of common responses given on the Group Rorschach, or on the validity scales of the MMPI. This suggests that there was no change in test-taking attitudes; scores on other post-isolation measures can be interpreted in the usual manner.

After isolation Cubicle subjects did change their evaluative ratings of 3 out of 16 concepts chosen as germane to confinement. They also displayed a relatively reduced fluency in written word association, particularly to stimulus words linked semantically to isolation. Since their oral associational fluency was unchanged during isolation, the post-isolation change could be a product of changes in coordination or in test-taking motivation. On tests of mechanical ability Cubicle

subjects showed definite post-isolation impairment of eye-hand coordination. On tests of reading comprehension they showed similar impairment.

These experiments have demonstrated a transitory period of relatively poor visuo-motor coordination following isolation. Such impairment of fine coordination may underlie some of the impairment of higher mental processes reported in earlier research.

Chapter 4

INTELLECTUAL EFFICIENCY

Knowledge of the effects of isolation and sensory monotony upon intellectual efficiency is obviously of great practical significance. Scott et al. (37) report a decline in intellectual performance during isolation. On a battery of seven tests (Kohs' blocks, digit-symbol substitution, Thurstone-Gottschaldt figures, the transcribing of a prose passage, McGill Picture Anomaly Test, Delta Blocks Test, and mirror drawing) given both before and after isolation, isolated subjects showed consistent impairment. On a battery of oral tests, which included mental multiplication, mental arithmetic, number series completions, making of words from given letters, and anagrams, given after 24 hours and again after 48 hours of isolation, isolated subjects showed similar but less pronounced impairment. Much of what seemed to be intellectual impairment on the post-isolation test, however, may have been a result of deterioration in fine eye-hand coordination. Vernon and Hoffman (14), on the other hand, reported improvement in the verbal learning performance of sensorially deprived subjects, suggesting that a decline in intellectual efficiency might not be uniform or universal.

EXPERIMENT I: INTELLECTUAL PERFORMANCE

Four tests based on Thurstone's Primary Mental Abilities (38) were adapted for auditory administration: (a) a special series of digit span items (Meyers et al., (39) to measure immediate memory (Thurstone's factor M); (b) the number of words beginning with a given letter that the subject could think of in three minutes, to measure verbal fluency (factor W); (c) a series of simple mental arithmetic problems, to measure numerical facility (factor N); and (d) a series of coin change-making problems, to measure inductive reasoning (factor I). A fifth test, successive subtraction, was later added to the battery. This test, which had been found sensitive to several experimental manipulations, involved successively subtracting 7 from a starting value of 100 until a final answer less than 7 was reached. The characteristics of these five brief tests, and their reliabilities are presented in Appendix Table C-1.

Procedures. The five tests were first given to both Cubicle and Control subjects about 19 hours before isolation, with about half of the subjects being in lighted and half in darkened test rooms. The tests were given again, after approximately 76 hours of isolation, this time, however, with all the Control subjects in lighted rooms. Appendix Table C-2 shows the total number of subjects who took each of the tests at each time and under each condition.

Results. On the pre-isolation tests, the distributions of raw scores for subjects tested in lighted rooms and those tested in dark rooms were highly skewed. Therefore, both sets of scores were dichotomized at their medians into high and low groups and each subject was given a score of 1 or 0 on each test. Subjects tested in the light were consistently superior, significantly so on inductive reasoning and successive subtraction.

Because of this, the pre-isolation test conditions had to be taken into account when comparing the during-isolation performances. Each subject was therefore categorized according to the condition under which he took his pre-isolation tests: light or dark. Since the analysis was to be done on change scores (the differences between pre-isolation and during-isolation scores), and these were found to be highly correlated with pre-isolation level of performance, it was also necessary to categorize each subject according to whether he scored above or below the median on each of the pre-isolation tests. Within each of these four categories the distribution of change scores was skewed. Accordingly, each distribution was dichotomized at the median and each subject was assigned a change score of 1 or 0 according to whether he fell above or below the median of his category. These dichotomous change scores were then analyzed by treatment group (Cubicle vs. Control) and level of pre-isolation performance (above or below the median). The results of these analyses are summarized schematically in Table 5.

The differences between Cubicle and Control subjects were significant on three of the five tests. Control subjects were superior in both verbal fluency and successive subtraction, Cubicle subjects in immediate memory. On numerical facility and inductive reasoning, the two groups performed quite similarly. Thus isolation apparently produced significant impairment on two tests, little effect on two, and significant facilitation on one.

Analyses of the scores of those 34 Cubicle and 34 Control subjects who took all five of the tests before and during isolation also showed the Control subjects to be superior to the Cubicle subjects on verbal fluency and successive subtraction, but inferior on immediate memory, although these differences were not statistically significant. Evidently isolation may impair or facilitate intellectual performance, depending upon the task. Further experimentation is needed to clarify the nature and source of this interaction.

EXPERIMENT II: REPORTED DIFFICULTY IN CONCENTRATING

Isolated subjects have characteristically reported difficulty in thinking (Scott et al., 37). Without comparable reports from Control subjects, however, these findings cannot be evaluated clearly.

On the post-isolation questionnaire many more Cubicle than Control subjects gave reports of intellectual inefficiency. Clearly, an impoverished sensory environment produces at least feelings of intellectual inefficiency.

Procedures. Three of the questionnaire items satisfied the criteria for a cumulative Guttman scale (Stouffer et al., 40):

Item	Scored Response	Cumulative Scale Seore
It was hard to keep my mind on one thing.	1	1
My ability to concentrate was worse than usual.	1	2
I was not able to control my thoughts	1	3

The coefficients of reproducibility obtained with four different samples of subjects were well in the direction of perfect reproducibility. In addition, in three of the same four samples, the number of perfect scale types greatly and significantly exceeded chance expectation (Schuessler, 41). Each subject was therefore assigned a scale score corresponding to his reported maximum level of difficulty in concentrating. Yes responses were scored at face value. A subject reporting no difficulty in concentrating was assigned a score of 0.

Table 5

Analyses of Dichotomous Change (Pre-Isolation to During-Isolation) Scores on the Intellectual Performance Tests

Test	Pre-Isolation Performance	Table of Means and Probabilities			
		Treatment group			
		Cubicle	Control		
Immediate memory	High	.54	.47	.51	NS
	Low	.61	.26	.44	
		.58	.37	Interaction	
		$p<.05$		NS	
		Treatment group			
		Cubicle	Control		
Verbal fluency	High	.44	.59	.52	NS
	Low	.42	.58	.50	
		.43	.59	Interaction	
		$p<.05$		NS	
		Treatment group			
		Cubicle	Control		
Numerical facility	High	.47	.53	.50	NS
	Low	.47	.53	.50	
		.47	.53	Interaction	
		NS		NS	
		Treatment group			
		Cubicle	Control		
Inductive reasoning	High	.53	.53	.53	NS
	Low	.53	.47	.50	
		.53	.50	Interaction	
		NS		NS	
		Treatment group			
		Cubicle	Control		
Successive subtraction	High	.33	.63	.43	NS
	Low	.38	.67	.53	
		.35	.65	Interaction	
		$p<.025$		NS	

Results. Although Cubicle subjects reported greater difficulty in concentrating (Table 6), they actually performed better on at least one of the tests. Among the 34 Cubicle subjects who took all the tests, the correlation between test score and scale score was significant for verbal fluency ($r = .57$) and for successive subtraction ($r = .33$), the tests on which the Control subjects did better than the Cubicle subjects.

Table 6

Reported Difficulty in Concentrating: Mean Scale Scores of Cubicle and Control Subjects

Data Period	*N*	*M*	*t*	*p*
First (runs 1-16)				
Cubicle subjects	117	2.13	7.43	.001
Control subjects	117	1.09		
Second (runs 17-23)				
Cubicle subjects	56	2.05	4.55	.001
Control subjects	81	1.14		

The most curious feature of these findings was the direction of the associations: Greater difficulty in concentrating was reported by Cubicle subjects who had done relatively well on the tests. This suggests that better-performing Cubicle subjects tried harder and experienced more difficulty in concentrating than did Cubicle subjects who did not try as hard and performed less well.

Disparities between subjective report and performance cannot be ignored or dismissed in deciding practical questions about the level of performance to be expected under extreme conditions, since subjects' feelings about their performance may become manifest in behavior not measured in the experiment. Subjective reports of intellectual inefficiency may well prefigure performance losses of a serious nature. To minimize their intrusiveness, the tests used in this study were kept simple and brief. More complex and continuing demands might reveal impairments with serious practical consequences.[1]

In many earlier studies, the expected decrements in performance had not been found; somehow, sleep-deprived subjects seemed able to rally, for a time, the effort necessary to withstand obvious decrement. Only when Williams and his associates (42) conceived of performance decrement in terms of momentary lapses and devised ingenious scoring methods to detect such lapses did they obtain clear-cut evidence of impaired performance. A similar approach might prove fruitful here.

SUMMARY ON INTELLECTUAL EFFICIENCY

The performances of Cubicle and Control subjects were compared on five auditorily administered intellectual tasks, given both before and during isolation. On the pre-isolation tests, the subjects who were tested in lighted rooms were found to be superior on inductive reasoning and successive subtraction. Analysis of the differences between the pre-isolation and during-isolation performances indicated that isolation apparently inhibited verbal fluency and successive subtraction, had no discernible effect on numerical facility and inductive reasoning, but facilitated immediate memory.

In retrospective appraisals of the difficulty they experienced in concentrating during isolation, the Cubicle subjects reported having had more difficulty than did the Control subjects. Among the Cubicle subjects, those who reported having the most difficulty tended to perform best on the intellectual tasks.

The somewhat obscure and equivocal nature of these and the earlier findings on intellectual efficiency during isolation suggests that new approaches be sought to the problem.

[1] A parallel may be found in a recent study of sleep deprivation (Williams *et al.*, 42).

Chapter 5

VIGILANCE AND ALERTNESS[1]

Typically, a vigilance task involves detecting and acting upon information that is presented infrequently and usually unpredictably, sometimes in monotonous surroundings, and often over prolonged periods. An almost universal finding is that the average probability of detection falls off sharply as time passes, even when the vigil lasts no more than 30 minutes.

Most of the research on vigilance has been in the visual mode. However, auditory vigilance has also been investigated, through the detection of changes in pitch or loudness of signal tones, or of one particular letter presented occasionally in a long sequence of other letters, or of a particular sequence of digits in a long series of digits.

MEASURE OF VIGILANCE

Vigilance was measured in this study by speed of reaction to a brief tone signal, presented at an average rate of 15 signals per hour, the individual signals coming anywhere from 2 to 6 minutes apart. The signal, a moderately loud tone far above threshold and the ambient noise level in the cubicles, was presented for one-tenth of a second against a background of silence. The subject responded by releasing a Lindsley manipulandum requiring 10 ounces of pressure to hold it out.

The vigilance test was programed and scored automatically so that as many as eight subjects could be tested simultaneously. The apparatus recorded the period from the onset of the tone to the release of the lever in twentieths of a second to a maximum of two seconds. A graphic recorder was programed to run at high speed any time a trial was in progress.

EXPERIMENTAL TREATMENTS AND TESTING

Auditory reaction times were measured before the beginning of the isolation period and again during isolation, just before and just after the vigilance test as a warm-up and to ensure that the subjects were awake and responding properly. Subjects estimated their levels of drowsiness and motivation just after the test.

Pre-isolation test. The pre-isolation test was a series of 30 tone signals averaging 15 seconds apart, ranging from 13 to 17 seconds apart. This was a conventional reaction time test with the previous tone signal used as the ready signal.

Each subject, lying on a bed in a cubicle, was instructed to pull out the lever, hold it out, and then release it as quickly as he could each time he heard the short tone signal. He was told he was being timed.

[1]See also Myers *et al.* **(43)**.

During-isolation test. The during-isolation test was administered after about 72 hours of isolation. It began with 15 signals identical with the first 15 of the pre-isolation test. The next 12 signals, the vigilance test, were presented successively 2, 6, 4, 2, 4, 6, 4, 6, 2, 4, 2, and 6 minutes apart. The test ended with 15 signals identical with the last 15 of the pre-isolation test.

One group of Control subjects was tested in lighted rooms, another in dark rooms, because recent research had suggested that light might facilitate performance (McGrath, 44).

During- and post-isolation questionnaires. Immediately after the test, the subjects were asked four multiple-choice questions about how sleepy they were before and during the test, and how hard they tried. They signaled their answers with the lever. In the post-isolation questionnaire also, subjects were asked how drowsy or sleepy they were, how hard they tried, how tired or bored they were, and how difficult the task seemed.

SUBJECTS

The data for this study were collected from 34 Cubicle, 34 Light Control, and 17 Dark Control subjects. These three groups did not differ significantly in age or general intelligence, nor did the 34 Cubicle subjects differ from the 22 who had withdrawn earlier.

RESULTS

Vigilance performance. Latency measures usually produce skewed distributions; these were no exception. There was also some heaping-up of scores at the upper extreme of the distribution. The scores given were the numbers of slow trials each subject had in the first half and in the second half of the 12 trials. A slow trial was one with a latency longer than the median latency for all subjects on all trials combined, in this case, .4 second.

Mean numbers of slow trials are given in Table 7. The statistical analyses shown in Table 8 indicate that:

(1) A significant vigilance effect occurred in all groups.
(2) The Cubicle subjects were more vigilant than the Dark Controls, but showed about the same decrement over time.
(3) The Cubicle subjects were about as vigilant as the Light Controls, but showed significantly less decrement over time.

The findings of an earlier study are quite consonant with these findings. In the earlier study the performances of 25 Cubicle subjects were compared with those of 25 Light Controls only.

An analysis, combining the data from the earlier study with comparable portions of the data from the present study, showed the divergence over time

Table 7

Mean Numbers of Slow Trials on Vigilance Test

Subjects	*N*	Vigilance Test	
		First Half	Second Half
Cubicle	34	1.4	2.0
Light Control	34	1.7	3.1
Dark Control	17	2.9	3.8

Table 8

Analyses of Numbers of Slow Trials on Vigilance Test

Subjects	*df*	*MS*	*F*	*p*
Cubicle and Light Control				
Between subjects	67			
Cubicle vs. Light Control	1	15.5	3.47	
Error (between)	66	4.47		
Within subjects	68			
Task halves	1	32.0	30.19	.001
Interaction	1	5.0	4.72	.05
Error (within)	66	1.06		
Total	135			
Cubicle and Dark Control				
Between subjects	50			
Cubicle vs. Dark Control	1	61.5	9.33	.01
Error (between)	49	6.59		
Within subjects	51			
Task halves	1	11.4	14.25	.001
Interaction	1	.3	.38	
Error (within)	49	.80		
Total	101			
Light Control and Dark Control				
Between subjects	50			
Light Control vs. Dark Control	1	21.3	4.35	.05
Error (between)	49	4.90		
Within subjects	51			
Task halves	1	35.3	27.36	.001
Interaction	1	1.7	1.32	
Error (within)	49	1.29		
Total	101			

between the Cubicle subjects and the Light Controls to be highly significant (Table 9). While Cubicle and Light Control subjects are about equally vigilant during the first half hour, Light Control subjects show the normal vigilance effect while Cubicle subjects may slow down a little or may become more vigilant.

Table 9

Analysis of Numbers of Slow Trials for Both Vigilance Studies Combined

Source	*df*	*MS*	*F*	*p*
Between subjects	117			
Primary vs. early study	1	5.5	1.13	
Cubicle vs. Light Control	1	30.6	6.28	.025
Interaction	1	0.1	0.02	
Error (between)	114	4.87		
Within subjects	118			
Task halves	1	23.9	22.55	.001
Task hnlves x studies	1	8.9	8.40	.001
Groups x task halves	1	11.0	10.38	.001
Triple interaction	1	0.2	0.19	
Error (within)	114	1.06		
Total	235			

Missed signals. Only a few signals were missed. A count of the missed signals, however, shows that 21% of the Cubicle subjects missed at least one signal as compared with 35% of the Light Control subjects, and 65% of the Dark Control subjects. Only the differences between the Dark Control subjects and the other two are statistically significant.

Reaction time. The data from the three reaction time tests were more amenable to conventional treatment. Although the distributions were skewed, each subject's median reaction time fairly characterized his performance (Table 10).

Table 10

Means of Median Reaction Times

(in seconds)

Subjects	*N*	Reaction Time Test		
		Pre-Isolation	During-Isolation	
			Before Vigilance Test	After Vigilance Test
Cubicle	34	.31	.29	.31
Light Control	34	.32	.30	.33
Dark Control	17	.31	.33	.37

Analysis based on median reaction times showed the three groups to be the same on the pre-isolation test. In the subsequent tests the Cubicle and the Light Control subjects remained about the same, but the Dark Control subjects showed increasingly slower reaction times. It is noteworthy that 72 hours of isolation did not affect the reaction times of the Cubicle subjects.

Questionnaire data. Two-thirds of all subjects indicated that they had been at least a little sleepy before they began the during-isolation tests. During the vigilance test, however, the Cubicle subjects were less drowsy than either the Light or the Dark Control subjects, who did not differ from one another. Both the Dark Control subjects and the Light Control subjects rated themselves as having tried harder than did the Cubicle subjects, although the two control groups did not differ significantly.

Although 66% of all subjects found the task tiring or boring, the three groups did not differ significantly. About three-quarters of each group agreed that it had been difficult or annoying to hold out the response lever for the entire period of the test.

SUMMARY DISCUSSION OF VIGILANCE

In brief, the findings are:

(1) The Cubicle subjects were more vigilant than the Light Control subjects; both were more vigilant than the Dark Control subjects.

(2) The least vigilant, the Dark Control subjects, were also the slowest in the reaction time trials, both before and after the vigilance test.

(3) Responses to retrospective questionnaire items appear to be related to vigilance: (a) The least vigilant (the Dark Control subjects) tried harder and were more sleepy than the others; (b) the Light Control subjects consistently fell between the others; (c) the most vigilant (the Cubicle subjects) were the least sleepy and tried the least.

While these findings contrast sharply with the clear-cut post-isolation degradation found in the visual vigilance of Cubicle subjects by Zubek et al. (45), it is impossible to say whether the findings are contradictory. Reports of the distractability of subjects following isolation and of changes in their perceptual and perceptual-motor functions at that time are, in general, consonant with Zubek's findings (Scott et al., 37; Vernon et al., 35). Sampling, quietness of test rooms, and the "set" of the subjects could not account for the present findings.

Since the restlessness of the Cubicle subjects increased during the vigilance test ($\chi^2 = 4.32$, $df = 1$, $p < .05$), it seems likely that they were hyper-alert at that time. Evidently, under the test conditions, Light Control subjects were normally alert, Dark Control subjects became increasingly less alert, while Cubicle subjects remained continuously hyper-alert. While some bias may stem from the early release of 22 Cubicle subjects, the fact that the early-release subjects reported significantly greater restlessness during isolation ($t = 2.08$, $df = 54$, $p < .05$), suggests that they might have performed as well or better than the remaining Cubicle subjects on the vigilance test. It is in any case clear that the commonly reported hypoarousal cannot account for the present findings.

Chapter 6

REPORTED VISUAL SENSATIONS

In the early experimental runs, many Cubicle subjects interviewed after isolation reported a variety of visual experiences: the totally dark cubicle seemed to be flooded with moonlight; it looked like the lights from cars passing on the highway; somebody opened the door to the cubicle and announced the time; every time the speaker came on for a test the corner of the room would light up; there was enough light to see the outlines of objects in the cubicle. Many asked if pictures had been flashed on the walls of their cubicles. These sensations possessed the qualitative characteristics of "real" visual experiences; they were three dimensional, and seemed real rather than imaginary, possessing the "out-thereness" characteristics of "real" visual events.

Subjects in other studies have reported visual sensations of one kind or another, from amorphous flashes of light and simple geometric forms to integrated scenes, imagery usually characterized by vividness and a sense of "out-thereness" and sometimes by repetitiveness beyond the subject's control.[1] Only in the studies done at Wright-Patterson Air Force Base (Ruff et al., 65) did the subjects report almost no hallucinatory experiences.

In none of these studies, however, was a relationship established between the duration of isolation and the occurrence of visual experiences. In none of them were data collected from Control subjects, nor were reporting and scoring procedures formalized. In most of them the findings seem to have been based either on spontaneous verbalizations made during isolation or on retrospective reports.

This study was designed to determine the effects of isolation upon the visual sensations reported during a 30-minute test period. Reports made by Cubicle subjects after several days of isolation were compared with reports made by Control subjects tested at the same time.

MEASUREMENT OF REPORTED VISUAL SENSATIONS

Hallucinations, illusions, and images are difficult to distinguish operationally. Since the observable responses are verbal reports, the measures must be applicable to such verbal reports. The system of measurement developed had:

(1) Standardized instructions, meaningful for both Cubicle and Control subjects.
(2) Instrumental recording of responses.
(3) A reliable, standardized system for scoring responses.

[1]Bexton, **2**; Bexton *et al.*, **4**; Doane, **6**; Doane *et al.*, **46**; Heron *et al.*, **47**; Heron, **48, 49**; Vernon *et al.*, **50, 51**; Vernon, **52**; Vernon and McGill, **53**; Zubek *et al.*, **45**; Solomon *et al.*, **17**; Solomon and Mendelson, **54**; Wexler *et al.* **20**; Cambareri, **55**; Cohen *et al.*, **56**; Davis *et al.*, **34**, Freedman and Greenblatt, **57**; Freedman *et al.*, **58**; Goldberger and Holt, **59**; Holt and Goldberger, **26**; Lilly, **13**; Pollard *et al.*, **60**; Shurley, **61**; Silverman *et al.*, **62**; Vosburg *et al.*, **63**; Zuckerman *et al.*, **64**.

(4) A measure sensitive to manipulation.
(5) Properties supporting the inference that the scores reflected visual experiences.

PILOT STUDY

This system of measurement was developed from a pilot study of the visual sensations reported during a 10-minute period in the dark (Murphy and Myers, 66). In this study, subjects were given either positive or negative instructions as well as practice in "seeing things," by means of an oral response to several Rorschach cards.

Subjects given positive instructions were told it was normal to have visual sensations in the dark; those given negative instructions were told that only psychiatric patients reported such experiences. The former reported significantly more frequent and more complex visual sensations than did the latter ($p < .025$). Practice in "seeing things," however, appeared to have no effect on their later reports.

Since, in a follow-up questionnaire, a majority of the subjects reported that the visual events appeared to lie outside themselves, to be three-dimensional, and to be real rather than imagined, their experiences evidently had some of the attributes of the hallucinatory experiences reported in sustained deprivation studies.

There is no unequivocal way of determining whether a subject reporting visual sensations is actually "seeing' something. In this pilot study a verbal report was admitted as evidence of a visual sensation if, and only if, the language or the report indicated that the subject was indeed "seeing" something in front of him. Reports were considered admissible or scorable only if they contained the verb see or one of its synonyms in the present tense and in the first or, occasionally, second person. Reports continuing after the disappearance of a transient sensation were also considered admissible.

A verbal report judged admissible was scored as falling in one of four categories of complexity (adapted from the classification used in the McGill University studies):

Reported Sensation	Category
Amorphous light or contrast in shade of darkness	1
Geometric forms	2
Single objects	3
Integrated scenes	4

Since analysis indicated that Guttman's scaling procedure (Stouffer et al., 40) could be applied here, a complexity score was assigned to each subject to indicate the highest level of complexity found in his reports. A subject reporting no visual sensations was assigned a score of 0.

MAIN STUDY

Procedures. For the main study, the positive instructions from the pilot study were used and the reporting time was extended to 30 minutes. In addition, a manual of scoring instructions developed in the pilot study was expanded by including relatively objective criteria for (a) breaking a protocol into separate and independent reports, (b) deciding whether a report was admissible, and (c) assigning each separate report to a category of complexity (Murphy et al., 67). Two scores were produced for each subject: a frequency score, the total number of sensations he reported; and a complexity (scale) score, the highest level of complexity found in his reports.

In the following fragments from a scored protocol, the portions in parentheses were judged to be separate and independent reports of visual sensations and the numbers over the parentheses show the scoring category to which each admissible report was assigned.

> "Right now I see (a purple[2] and violet red lines with a black center). It's (taking[3] the form of a honeycomb, black and purple) . . . I see (blue[1]) and (yellow[1]) . . . I see (a confused[1] mass of colors, seems to be changing forms) . . . I can see (purple[3] and blue[1] in the shape of a piece of rock. It appears to have holes in it) . . . I see (a lot[1] of different colors) . . . I can see (flowers[4], yellow flowers with green leaves with a blue tinge to it) . . . I can see (a tree[4] with no leaves, it's a dead tree) . . . Looks like you been looking at a light and turned it off. It's the same effect you get . . . I see (a lot[1] of different colors)."

In judging the total number of separate and independent reports in the 72 protocols, two scorers were in perfect agreement 61% of the time and differed by no more than two reports 90% of the time. In assigning complexity scores, the two scorers were in perfect agreement in 63% of the cases and differed by no more than one point in 90%. The scores finally assigned to each subject were the averages of the scores given by the two scorers.

Since complexity was scalable, subjects with higher complexity scores tended to have higher frequency scores as well. Analyses showed the two to be closely but not perfectly related.

Data collection. In all, 35 Cubicle and 37 Control subjects took this 40-minute test. In four runs it was given after about 72 hours and in two, after about 48 hours of isolation. The Control subjects, lying on beds in dark test rooms or cubicles, took the test on the same schedule as the Cubicle subjects.

Reported visual sensations during isolation. Visual sensations were commonly reported. Although about a quarter (8 each) of the Cubicle and the Control subjects reported nothing, the rest reported from one to 98 sensations. Both groups of subjects reported almost equally often, while the two most prolific subjects (83 and 98 reported experiences) were Control subjects. All that is needed for such sensations is darkness during the test period. It seems to make little difference whether the subject has been isolated or deprived earlier. Subjects such as these, when placed in the dark, are very likely to experience visual sensations. The mean level of complexity was not substantially different for the Cubicle subjects (1.73) and the Control subjects (1.64).

Subjects in other runs, tested after 72 hours or 96 hours of isolation, made about the same number and complexity of reports. Two to four days of isolation seem to affect neither the frequency nor the complexity of visual sensations experienced during 30 minutes in the dark.

ANCILLARY STUDIES

In another run, 8 Cubicle subjects and 11 Control subjects were asked, after 72 hours of isolation, to report all of the things they were imagining or picturing in front of them. When the protocols were scored, with changes in scoring paralleling the broader content, the reliability of the scoring was found to be similar to that obtained earlier. The categorized reports were not scalable, however, perhaps because the emphasis on imagery placed a greater premium on responses in categories 3 and 4. Although the frequency scores were higher, there was no reliable difference between Cubicle and Control subjects, nor was there any difference in the sheer number of words used.

In another set of runs, 26 Cubicle and 32 Control subjects were instructed after either 76 or 94 hours of isolation to note and remember the visual sensations occurring to them during a 30-minute period. At the end of this period all subjects signaled their answers to a standard set of questions by pulling a lever. Pilot studies had shown the verbal form and this nonverbal form of the measure to be highly correlated. Again there was no difference between the scores of the Cubicle and Control subjects. Suppression of verbal fluency in isolation evidently cannot account for the earlier lack of difference.

Although the scores of the Control subjects might have been raised by the persistence of normal visual experiences in the form of afterimages and phosphenes, particularly in the early part of the test, the Cubicle subjects had a higher mean score in the first 10 minutes of the test while the Control subjects had a higher mean in the last 10 minutes.

In another study, 36 naive subjects were assigned to each of three treatments: Immediate, Delayed, and Wake-up. Subjects in the Immediate treatment took the test soon after they entered the cubicles (as did the Control subjects in the primary study). Subjects in the Delayed treatment waited 30 minutes in the dark before they took the test. Subjects in the Wake-up treatment did mental arithmetic problems in the last 7 minutes of a similar 30-minute waiting period. The mean complexity scores of the Immediate and the Delayed subjects differed significantly, but the scores of the Immediate and the Wake-up subjects were similar. Evidently a period of dark adaptation does not affect the complexity of reported visual sensations if the subjects are kept awake before the test.

A number of other investigations were made of the ways in which subjects' motivation, expectancies about the experiment, and desires to carry out their roles in the approved fashion (Orne, 68) might bias the comparisons of the primary study. These investigations consistently failed to show that the factors under study could have unduly affected the basic experimental findings.

POST-ISOLATION REPORTS OF VISUAL SENSATIONS

Procedure. The post-isolation measure of visual experiences was four items in the post-isolation questionnaire. The subjects were asked whether, during the entire time they had spent in the experiment, the following four events had occurred "never," "once or occasionally," or "frequently":

(1) While I was in the dark I was aware of bright flashes in my eyes.
(2) In the dark I noticed various geometrical shapes that seemed to float before my eyes.
(3) I saw objects I knew were not there but looked real just the same.
(4) In the dark I seemed to see people and scenes that were not part of my thoughts or memories.

These items paralleled the complexity of report categories of the during-isolation measure. In one set of experimental runs the subjects took both the during- and the post-isolation tests. A significant correlation between the two sets of scores supported the assumption that both were measuring the same experiences.

Since these responses were scalable, each subject was assigned a complexity score as well as a relative frequency score based on weight of 0 for "never," 1 for "once or occasionally," and 2 for "frequently."

Data collection. The 35 Cubicle and 37 Control subjects who took the during-isolation test were also given the post-isolation test. The subjects in 10 later experimental runs were given only the post-isolation test.

Results. Table 11 lists the mean post-isolation frequency and complexity scores. The differences between both sets of Cubicle and Control subjects were highly significant. The during-isolation test evidently has a sensitizing effect that is about the same for Cubicle and Control subjects (the interactions were not significant).

Table 11

Mean Post-Isolation Frequency and Complexity Scores of Subjects Who Did and Did Not Take the During-Isolation Test

Subjects	*N*	Frequency	Complexity
Took Test			
Cubicle	35	3.17	2.46
Control	37	1.54	1.43
Did Not Take Test			
Cubicle	67	2.18	1.79
Control	66	.21	.24

Further studies indicated that volunteering, knowledge of experiment, and ability to predict experimental outcome did not contribute to the differences observed.

SUMMARY OF REPORTED VISUAL SENSATIONS

During isolation, subjects were asked to report all of the visual sensations they were actually experiencing during a 30-minute reporting period in the dark. After isolation, subjects were asked to answer questionnaire items about visual experience by retrospectively reviewing their entire time in the experiment.

The primary findings were:

(1) On the during-isolation test a majority of the subjects reported visual sensations. There was no difference between Cubicle and Control subjects in either the frequency or the complexity of the visual sensations reported.

(2) On the post-isolation test significantly more frequent and more complex visual sensations were reported by Cubicle subjects. Frequency and complexity were enhanced for subjects who had taken the during-isolation test. Prior isolation does not heighten reported visual sensations; it merely provides the Cubicle subjects with more chance to have them.

Chapter 7

DESIRE FOR STIMULATION

Hebb (8) has suggested that a person tends to seek median levels of stimulation; deviations from these cause him to seek more or less stimulation as required to return to a normal balance. As one of its primary effects a sensorially reduced environment appears to upset the normal levels and balances of sensory inputs. It is to be expected, then, that a man in isolation seeks increases in sensory input to restore his desired level of stimulation.

Retrospective reports suggest that the subjective value of certain stimuli increases in isolation. While some Cubicle subjects found sounds exciting after several days of isolation, others seemed to "encapsulate" themselves by remaining quiet and generally very passive, apparently trying to reduce the stress of isolation by not thinking about the stimulations of the outside world.

Pilot investigations of stimulus hunger used operant conditioning procedures. In a typical study the subject was told: "If you pull and release the lever something may happen that will not be harmful in any way." Both variable and fixed ratios of reinforcement were tried, using various auditory stimuli as reinforcers. It quickly became clear, however, that the subjects' intense curiosity and interest in trying to figure out the experimental procedure was more important than the schedule of reinforcement. In later experiments, a simple one-to-one ratio was used.

EXPERIMENT I

The first experiment examined stimulus-seeking after 48 hours of isolation. The reinforcement was either dinner music or white noise and the specificity of the instructions was varied.

Half of the subjects were told: "If you pull and release the lever it may cause something to happen which will not be harmful in any way." The other half were told that pulling and releasing the lever might result in a brief period of music, or of noise, or of nothing. Actually, each lever pull that occurred after the previous reinforcement had ended resulted in 7.5 seconds of sound, pleasant dinner music for half of the subjects and low volume white noise for the other half.

The responses of each subject were accumulated and printed out automatically after each minute of the experiment.

All of the Cubicle subjects pulled the lever more often than the least responsive third of the Control subjects when music was the reinforcement. The difference was not statistically reliable, however, because most of the subjects kept the music going for almost the entire 30 minutes of the experiment. Large variances clouded the statistical comparisons among the subjects reinforced by noise, which Cubicle subjects frequently and Control subjects rarely found annoying.

EXPERIMENT II

A 500-cps tone was substituted for the music and the length of the test period was increased from 30 to 40 minutes for 32 Cubicle and 33 Control subjects. The "something may happen" instructions were used. The data were collected near the end of isolation.

In this experiment the Cubicle subjects showed a slight and unreliable tendency to pull the lever over a longer period of time.

The ambiguity of the instructions apparently accounted for a great deal of the lever pulling. Subjects said they pulled to find out what the experimenters were doing, to see if things would change, to see how the equipment worked, to see if they could store up reinforcements by pulling frequently for a while and then listening, and so on. New and more explicit instructions were therefore written.

By now it was becoming clear that many Cubicle subjects just wanted to be left alone until the four days were over. Any need they felt for stimulation seemed to be offset by concomitant annoyance or irritation which produced ambiguous feelings about any save extremely pleasant sounds. This led to two studies based on annoyance alone, since that was more easily controlled than pleasure.

EXPERIMENT III

A moderately loud white noise was presented for a 30-minute period. The subject could get as many 7.5-second periods of silence as he wanted by pulling and releasing the lever. The instructions given to all subjects included the the following:

> Mounted on the wall to your right is a lever. During this task you will hear a moderately loud noise over your speaker, like this (play noise). If, after I tell you to start, you pull and release the lever you can turn the sound off for a short period of time. . . .

Data were collected just before the end of isolation. On the average, Cubicle subjects turned off the noise more often, but the difference was not statistically reliable. The point at which they last pulled the lever to stop the noise, however, did show a clear and reliable difference. After 20 minutes, 15 of the 19 Cubicle subjects but only 9 of the 21 Control subjects were still pulling the lever to turn off the noise, while 4 Cubicle and 11 Control subjects stopped by the end of the eighth minute ($\chi^2 = 4.17$, $df = 1$, $p < .05$).

Since the noise reminded many subjects of "waterfalls" or "the ocean," and other pleasant things, a further change was made to give the noise a more uniformly negative connotation.

EXPERIMENT IV

Two changes were made in the procedure for this experiment. First, the 30 Cubicle and 35 Control subjects were told: "You may find the noise moderately loud and unpleasant." Second, after isolation, the subjects were asked specific questions about the reasons for their performance on the "noise off" test.

The differences were more striking this time. For example, 17% of the Cubicle subjects but 46% of the Control subjects never turned off the noise while 33% of the Cubicle subjects and only 11% of the Control subjects kept the noise off virtually the entire time. Further, 70% of the Cubicle subjects but only 23% of the Control subjects were still pulling the lever and turning off the noise by the 20th minute of the 30-minute experiment.

Median analyses (Tables 12 and 13) showed that Cubicle subjects turned off the noise more often than did Control subjects and kept on doing so for a longer time.

Table 12

Frequency of Lever-Pulling During Testing With Unpleasant Noise [a]

Subjects	*N*	Lever Pulls	
		6 or Less	7 or More
Cubicle	30	8	22
Control	35	24	11

[a] $X^2 = 11.31$, $df = 1$, $p < .001$

Table 13

Persistence of Lever-Pulling During Testing With Unpleasant Noise [a]

Subjects	*N*	Last Lever Pull	
		14th Minute or Before	15th Minute or Later
Cubicle	30	7	23
Control	35	25	10

[a] $X^2 = 14.95$, $df = 1$, $p < .001$

More Cubicle than Control subjects found the noise unpleasant and cited irritation or noise avoidance as the reason for having turned it off, while fewer of them were reminded of pleasant things by the noise, or were able to ignore it by falling asleep. Most subjects had no idea what the test was about.

SUMMARY ON DESIRE FOR STIMULATION

Four experiments compared the stimulus-seeking of Cubicle and Control subjects. No statistically reliable differences were found in their seeking of music, a 500-cps tone, or white noise. Cubicle subjects were, however, more persistent in turning off a loud annoying noise than were Control subjects.

The threshold of annoyance or irritation is apparently lowered in Cubicle subjects. The absence of clear-cut evidence of stimulus-seeking by Cubicle subjects indicates that the situation is more complex than it appears. Many Cubicle subjects seem to have been able to remain in their cubicles by virtually encapsulating themselves. They often remained silent, trying even in their thoughts to avoid contact with the outside environment as much as possible. Many mentioned the excitement they felt on hearing meaningful sounds, and the resentment they felt because those sounds were a reminder of the more varied environment they were not yet free to return to.

Chapter 8

CONFORMITY TO A GROUP NORM[1]

It has been suggested that in confinement prisoners of war give greater weight to the judgment and opinions of others than they normally would. This increases their vulnerability to group pressure techniques designed to increase conforming or compliant behavior. This study was therefore designed to explore the effect of sensory deprivation and social isolation on an individual's ability to maintain independent judgment in the face of contrary group pressures.

THE MEASURE OF CONFORMITY

Many excellent techniques have been used to investigate the extent to which an individual is willing or able to resist group influences and reach independent conclusions (Asch, 70; Blake and Brehm, 71; Crutchfield, 72; Sherif, 73; and Tuddenham, 74).

The test of Conformity to a Group Norm used in the present study is much like that used by Blake and Brehm (71). It consists of a series of multiple-choice problems involving the counting of staccato tones resembling Morse code. The subject is told he will hear the answers of four other subjects being tested at the same time, but actually these voices are recorded. Each subject comes under the influence of the same three respondents, since he is always the fourth in the reporting sequence. This test was (a) brief, to minimize its intrusion into isolation; (b) auditory and amenable to standardized presentation; (c) simple, involving relatively easy perceptual judgments; and (d) sensitive enough to show errors of judgment attributable to compliance to incorrect group norms.

COLLECTION OF DATA

The subjects in this study were 39 long-staying Cubicle subjects (out of 58 who started) and 40 Control subjects. This subsample was virtually identical in age, GT score, volunteering rate, and early release rate with the total sample of participants in the entire program. Cubicle and Control subjects did not differ significantly in age, GT score, or pre-isolation ability to make accurate judgments on the kind of perceptual problem used in this test.

On the day before isolation, each subject was placed in a cubicle alone and given a set of 12 problems. Each problem consisted of four series of brief, 900-cycle tone segments presented at a rate of 5.3 segments per second and sounding like rapid Morse code dots. The first, or "standard," series was followed by three "comparison" series; only one was the same as the standard. The subject's task was to report which one of the three exactly matched the standard.

The conformity test itself, given after about 72 hours of isolation, consisted of 18 problems like those above. This time, however, the subject was told that

[1]See also Smith *et al.* (69).

he was one of five men performing the task simultaneously, each in a separate room and that he would hear the answers given by the other four in turn. Since the subject was fourth in the reporting sequence, he heard three answers before and one after he gave his own.

On 12 of the 18 problems, all or nearly all of the recorded voices gave the correct answer, but on the remaining six they agreed upon a wrong answer. A subject who went along with the consensus on the wrong answer made a "conformity error." One who made an actual error on any of the other 12 problems made a "nonconformity error."

RESULTS

A tabulation of the errors made on the pre-isolation test showed no difference in the skills of Cubicle and Control subjects. On the during-isolation test, all subjects were clearly influenced by the consensus, making a total of 140 conformity errors (agreed with wrong answers) but only 30 nonconformity errors (disagreed with right answers) ($t = 6.75$, $df = 77$, $p < .001$). There was no significant difference in the distribution of the conformity errors made by Cubicle and Control subjects. The 38% of the subjects who made no errors on the pre-isolation test made only 36 (25%) of the conformity errors in the during-isolation test while the others made 104 ($t = 2.15$, $df = 78$, $p < .05$). More skilled subjects apparently conform less.

The conformity errors made by the 49 subjects who made one or more errors on the pre-isolation test were analyzed. Those with more than the median number of conformity errors were given a conformity score of 1; those with fewer were given a conformity score of 0. They were then classified as (a) Cubicle or Control subjects, (b) above or below the group median of errors on the pre-isolation test, and (c) above or below the group median in intelligence (GT).

A summary of this analysis is given in Table 14. Evidently Cubicle subjects of lower intelligence (mean conformity score .82) were more likely to be influenced than were those of higher intelligence (mean score .36), while among the Control subjects susceptibility to group influence appears to be unrelated to intellectual level (mean of lower intelligence group .43, of higher intelligence group .46). Insight into the purpose of this experiment, as expressed in the post-isolation questionnaire, had no effect on conformity errors.

Table 14

Analysis of Conformity Scores of Cubicle and Control Subjects, Grouped by Intelligence and Pre-Isolation Test Errors

Source	*df*	*MS*	*F*	*p*
Cubicle vs. Control (A)	1	.301	1.37	
Intelligence (B)	1	.106	< 1	
Pretest errors (C)	1	1.349	6.13	.05
A x B	1	.909	4.13	.05
A x C	1	.045	< 1	
B x C	1	.457	2.08	
A x B x C	1	.006	< 1	
Error	41	.220		

SUMMARY ON CONFORMITY TO A GROUP NORM

Under the relatively mild stress of isolation, less intelligent (but above average) Cubicle subjects who were also prone to errors in simple perceptual judgment were found susceptible to implicit group pressures toward conformity. This suggests strongly that greater isolation stress, less intelligence, a need for more complex discriminations in a more complex task, and explicit group pressure could all be expected to increase conformity.

Chapter 9

PROPAGANDA AND ATTITUDE CHANGE

The effects of perceptual isolation upon changes in belief in the existence of ghosts, poltergeists, and the phenomena of extrasensory perception were appraised in a study by Scott et al. (37). After 18 hours of isolation (frosted goggles, a masking noise from a ventilation fan, and cardboard cuffs extending beyond his fingertips) each subject heard nine recorded "propaganda" lectures. He was then told that he could hear them again as often as he wished, one lecture following each request. Each Control subject had the same experience in a bare, lighted room. Appropriate attitude scales were given before and after this exposure to propaganda.

The initial attitudes of the college students used as subjects in this study were surprisingly neutral rather than skeptically negative. Bexton, in reference to an earlier study (2), commented that "most subjects had read little and knew little about such evidence as might be used either in support of or opposition to psychic belief." Perceptually isolated subjects made more requests for the lectures and, after hearing them, shifted more toward belief in psychic phenomena than did Control subjects. They also rated the topic of psychic phenomena as more interesting and more important than did Control subjects.

ATTITUDE CHANGE

This study, essentially a replication of the one above, was designed to test its results by influencing subjects' attitudes toward some specific entity, in this case the Turks, about whom they had already expressed definite opinions.

Attitudes were measured along the Evaluative dimension of the Semantic Differential (Osgood, 32). Two propaganda messages were prepared, one positive and one negative in its reflections upon Turkey and its people. Each message lasted approximately 3 minutes and was factual, although one-sided. Pilot experiments demonstrated that both selections could produce changes in attitudes.

Forty-five Cubicle subjects and 64 Control subjects were tested after 48 hours of isolation. Each subject's initial attitude was measured in a pre-isolation test. He was then earmarked to receive whichever recording (positive or negative) was opposed to his initial bias.

During a 75-minute request period, each subject was permitted to hear the 3-minute recording as often as he wanted. Immediately afterward, he rated Turks on a scale of "good-bad" closely correlated with the Evaluative dimension of the Semantic Differential. Retention of the content of the propaganda message was also measured at this time by an auditory test.

Four scores were obtained on each subject: the number of requests he made, an initial and a final attitude score, and a retention score.

FINDINGS

Most subjects asked for relatively few replayings; a few requested a good many. Request scores of 0 and 1 were given to subjects below and above the median, respectively. The subjects were then classified as (a) High or Low GT, (b) Extreme or Moderate, on initial attitude, and (c) Positive or Negative, on type of propaganda heard. The mean request scores of these 16 groups are given in Table 15. Analysis of these scores showed only that the Cubicle mean was significantly higher than the Control mean ($p < .025$) and the positive propaganda was more popular than the negative ($p < .025$). These results accord with Bexton's.

Table 15

Mean Request Scores of Cubicle and Control Subjects in Attitude Change Study

Classification		Subjects				Combined
		Cubicle ($N = 45$)		Control ($N = 64$)		
Initial Attitude	Propaganda	High GT	Low GT	High GT	Low GT	
Negative						
Extreme	Positive	.75	1.00	.67	.75	.61
Moderate	Positive	.80	.50	.20	.43	
Positive						
Moderate	Negative	.44	.50	.14	.37	.37
Extreme	Negative	.43	.60	.17	.33	
Combined		.58		.39		

Mean attitude change scores, based on the differences between pre-isolation and during-isolation attitudes, are given in Table 16.

Statistical analyses showed only that the attitudes of subjects with extreme initial views changed more than the attitudes of subjects with moderate initial views ($p < .05$), probably because they started on portions of the scale where greater change was possible. Again there was a tendency ($p < .10$) for the less intelligent Cubicle subjects to be the more susceptible to influence.

Table 16

Mean Attitude Change Scores of Cubicle and Control Subjects

Classification		Subjects			
		Cubicle		Control	
Initial Attitude	Propaganda	High GT	Low GT	High GT	Low GT
Negative					
Extreme	Positive	1.8	5.3	5.5	5.4
Moderate	Positive	2.0	4.2	3.6	3.9
Positive					
Moderate	Negative	2.3	3.7	4.3	3.3
Extreme	Negative	4.0	7.0	6.3	6.2

Retention was not clearly related to attitude change or amount of exposure to propaganda or to any of the classification variables used above.

DISCUSSION

Scott et al. (37) and Suedfeld (75) report that greater attitude changes took place among isolated subjects than among normal Control subjects. However both of these studies emphasized new learning experience, the acquisition of new responses in the absence of interference from conflicting prior responses. The findings of both are thus in keeping with the general consensus that sensory deprivation tends to facilitate learning. By contrast, the present experiment required subjects first to relinquish and then to reverse a response. The conspicuously small change in the attitudes of the more intelligent Cubicle subjects and the absence of conformity among similar subjects in the previous experiment suggests that they were actively resisting attempts to influence them.

It would appear that isolation increases the susceptibility of subjects to being influenced, but that attempts to influence them may arouse some resistance depending upon their sensitivity to the manipulative intent of the test procedures. Apparently the conformity and propaganda tests were obvious enough to arouse a fair amount of resistance, while the procedures of Scott et al. and of Suedfeld were not. More intelligent subjects can be expected to be more sensitive to manipulative intent, in part because they more quickly learn the responses behind which the manipulative intent is concealed and therefore have more time to discover the attempt being made to influence them.

SUMMARY OF PROPAGANDA AND ATTITUDE CHANGE

In an experiment concerned with self-exposure to propaganda and its effect upon attitude changes, Cubicle subjects requested more repetitions of the propaganda than did Control subjects. However, their evaluative attitudes did not shift more than did those of Control subjects. The data suggest some tendency for the more intelligent Cubicle subjects to be especially resistant to the propaganda.

Chapter 10

CONDITIONING OF CONNOTATIVE MEANING

The final experiment in this series was also concerned with relative changes in the attitudes of Cubicle and Control subjects. In this experiment, however, the changes in attitude were reflected in shifts in the connotative meanings attached to the names of certain national groups and were brought about by a conditioning procedure.

The usual model of attitude change is operationally vague: When subjects are exposed to propaganda, their attitudes somehow change. It is not surprising, therefore, that in articulating the model with operational reality, different experimenters do different things and get different results. From the studies based on this model it can be concluded only that isolation appears to have some effect upon attitude change; the conditions under which it is an important factor remain obscure.

In recent years, Osgood and his associates (32, 76, 77) and, following them, Staats and Staats and their associates (78-85) have worked out and validated empirically a model that gives operational specificity to attitudes and to the processes by which they may be evaluated and changed. Although this model may not exhaust the possible approaches to attitude measurement, its simplicity and explicitness more than make up for a possible narrowness of scope.

They have taken a subject's attitude toward an object to be the evaluative component of his semantic response to the object on Osgood's Semantic Differential. They assert that changes in attitudes are (or can be) the result of simple conditioning—the persistent pairing in his experience of the object with other objects toward which he has different evaluative responses or attitudes. Staats and Staats have shown empirically that this is the case—that, by appropriate conditioning procedures, attitudes and the other components of semantic response can be modified predictably and independently.

The conditioning procedure is a simple one. Subjects are presented with two lists, the one of such objects as concepts, words, nonsense syllables, or names of national groups, to which they have already made some evaluative response, the other of adjectives and adverbs that elicit known semantic responses. Each item on the first list (the conditioned stimuli), is paired by design with a particular item or class of items on the second list (the unconditioned stimuli). The subjects learn the two lists simultaneously and then rate the items of the first list again on some form of the Semantic Differential. The changes observed in their evaluative responses to items are interpreted as changes in their attitudes toward those items.

Preliminary experimentation showed that (a) the conditioning procedure outlined above was effective with Army subjects, (b) the magnitude of the conditioning effect was a monotonic function of the number of times a word was paired with members of a class of adjectives or adverbs up to at least 28 times, and (c) the conditioning effect was the same whether the critical conditioning pairs were presented in a block or were separated and embedded in a series of otherwise neutral pairs.

CONDITIONING LISTS

A pilot study had shown the semantic responses to Greeks, Armenians, Italians, and Poles to have similar variances and essentially neutral means on the evaluative dimension of the Semantic Differential. These names were therefore selected to be used as the conditioned stimuli.

Two alternative lists of conditioning pairs were made up. On one list, Greeks was paired with 14 adjectives or adverbs (beautiful, valuable, kind, happy . . .) previously found (Jenkins et al., 86; Osgood et al., 76) to elicit semantic responses high on the evaluative dimension but scattered unsystematically along the other two, and Armenians was paired with 14 adjectives (ugly, worthless, cruel, angry . . .) eliciting semantic responses low on the evaluative dimension but scattered unsystematically along the other two. On the other list these pairings were reversed: Greeks was paired with the low evaluative and Armenians with the high evaluative words. On both lists, Italians and Poles were paired with 14 different words (obscure, shady, wet, frosty, lofty, long, suddenly . . .) found to elicit semantic responses falling near the midpoint of the evaluative dimension and scattered unsystematically along the other two. The neutral pairings of one list were reversed in the other.

Each pairing of a name and a word occurred twice on each list and therefore each of the four names was paired 28 times with a member of its assigned class of adjectives or adverbs. Each list of 112 pairs was arranged in random order with the restriction that each name appear the same number of times in each quarter of the series.

CONDITIONING TRIALS

Just before the conditioning trials the subjects were told they were to learn two lists of words but that to make the task more difficult the words would be presented in pairs, one from each list. They were told to repeat each pair of words aloud immediately after hearing it and also that they would be tested later on their recall of the words. A randomly selected half of each group of subjects, Cubicle and Control, was assigned to hear each of the two lists.

Immediately following the conditioning trials, the subjects were given one minute to recall the national groups and three minutes to recall the adjectives and adverbs.

SEMANTIC DIFFERENTIAL MEASURE

About 10 minutes later the subjects were asked to rate five national groups (Japanese, Greeks, Poles, Armenians, Italians) on each of nine 7-point, bipolar scales of the Semantic Differential. None of the words used had appeared in the conditioning lists. The order and the polarity of the ratings were counterbalanced.

PRE- AND POST-ISOLATION MEASURES

Before isolation the subjects were asked to rank-order a set of 14 national groups, including Greeks, Armenians, Italians, and Poles, with respect to how well they would like to have them as neighbors.

After isolation, all subjects took a paper-and-pencil version of the nine Semantic Differential scales and then a questionnaire that included questions about the purpose and effects of the conditioning procedure.

SUBJECTS

Among 124 subjects in this study, Cubicle and Control subjects did not differ from one another or from the Cubicle subjects who requested early release.

The conditioning trials and the subsequent tests were given approximately 48 hours after the beginning of isolation and took about 40 minutes. Control subjects were tested in dark, quiet rooms.

RESULTS

A subject's attitude score on a national group was the sum of his three evaluative ratings of the group on the mode just after conditioning, low if in the good-pleasant-clean direction, high if in the bad-unpleasant-dirty direction.

The effectiveness of the conditioning procedure was measured by the difference between a subject's attitude scores on the two groups, the sense of the difference depending upon which conditioning list he heard.

The subjects' pre-isolation attitudes were used to classify them as Targets, whose initial ranking of the two groups were contrary to the intent of the lists they heard, and Nontargets, whose initial rankings of the two groups were consonant with the intent of the lists they heard. They were also classified by experimental treatment (Cubicle vs. Control) and by intelligence level (High GT vs. Low GT).

The great heterogeneity of their variances made a statistical analysis of the conditioning scores impossible. They were therefore rank-ordered. Mean conditioning rank-scores are shown in Table 17. While analysis found no significant differences among them, the borderline significance ($p < .10$) of the interaction between experimental treatment and GT level suggested that Low GT Cubicle subjects were more susceptible to the conditioning procedures than any of the other groups.

Table 17

Mean Conditioning Rank-Scores of Cubicle and Control Subjects

GT	Cubicle Subjects			Control Subjects		
	N	Mean	Combined Mean	*N*	Mean	Combined Mean
High						
Target	19	55.0	60.0	13	55.0	61.6
Nontarget	14	65.0		15	68.1	
Low						
Target	13	79.2	75.2	13	44.3	53.4
Nontarget	16	71.1		21	62.6	

Since the Target vs. Nontarget classification is a rather weak indicator of pre-isolation attitude, the rank each subject gave one group on the pre-isolation test was subtracted from the rank he gave the other, the sense of the difference depending upon which conditioning tape he was exposed to. The subjects were then rank-ordered on the size of that difference. This gave each subject a pre-isolation attitude rank-score paralleling his during-isolation conditioning rank-score. The difference between these two ranks reflects the change produced in his pre-isolation attitudes by the conditioning procedure.

The means of these rank differences for the various groups of subjects are given in Table 18 and analyzed in Table 19. Low GT Cubicle subjects clearly responded most to the conditioning procedures while the other three groups all showed about the same level of response. The borderline significance of the Cubicle-Control difference suggests that, in general, Cubicle subjects are a little more susceptible to the conditioning procedures.

Table 18

Mean Differences of Rank-Scores (Pre- vs. During-Isolation Ranks) of Cubicle and Control Subjects

GT	Cubicle Subjects			Control Subjects		
	N	Mean	Combined Mean	*N*	Mean	Combined Mean
High						
Target	18	123.9	97.4	13	123.9	101.0
Nontarget	13	70.9		15	78.1	
Low						
Target	13	150.1	122.8	13	115.4	94.4
Nontarget	16	95.5		21	73.5	

Table 19

Analysis of Mean Differences of Rank-Scores (Pre- vs. During-Isolation Ranks) of Cubicle and Control Subjects

Source	*df*	*MS*	*F*	*p*
High GT vs. Low GT (A)	1	2,619.74	1.92	
Target vs. Nontarget (B)	1	70,722.95	51.77	.001
Cubicle vs. Control (C)	1	4,540.73	3.32	.10
A x B	1	9.56		
A x C	1	7,578.84	5.55	.025
B x C	1	745.08		
A x B x C	1	53.33		
Error	114	1,366.23		

Osgood and Tannenbaum (77) have pointed out that the attitude taken by a subject reflects not only his attitude toward the "message" but also his attitude toward its source. As shown earlier, more intelligent Cubicle subjects tend to resist attempts to change their attitudes by propaganda messages. In the present study the technique of persuasion was more subtle, but it did not deceive everyone. Of the 114 subjects who took the post-isolation questionnaire covering this study, 31 realized the purpose of the conditioning procedure, but 83 did not appear to. The consequences of this are shown in Table 20, a tabulation of the mean conditioning rank-scores of Cubicle and Control subjects who did and did not correctly identify the purpose of the conditioning procedure. Table 21 shows the analysis of these scores. Cubicle subjects who correctly perceived the purpose of the experiment evidently resisted conditioning, while the corresponding Control subjects were conditioned as intended.

The subjects who did not correctly identify the purpose of the conditioning procedure were then classified by Experimental Treatment and GT, and as Target or Nontarget. The original unranked conditioning scores of these

Table 20

Mean Conditioning Rank-Scores of Cubicle and Control Subjects, Grouped by Identification of Purpose

Identification of Conditioning Procedure	Cubicle Subjects		Control Subjects	
	N	Mean	*N*	Mean
Correct	13	46.3	18	61.0
Incorrect	45	65.5	38	49.0

Table 21

Analysis of Mean Conditioning Rank-Scores of Cubicle and Control Subjects, Grouped by Identification of Purpose

Source	*df*	*MS*	*F*	*p*
Correct Identification of Conditioning Procedure vs. Incorrect (A)	1	372.36		
Cubicle vs. Control (B)	1	41.78		
A x B	1	5,752.68	5.55	.025
Error	110	1,036.46		

subgroups were found to be homogeneously variable. Table 22 shows the mean conditioning scores of the various subgroups and Table 23 the analysis of these scores. It is clear that, among noninsightful subjects, Cubicle subjects are more easily conditioned than Control subjects and the less intelligent among them are the most easily conditioned, while the less intelligent Control subjects are the least likely to show any conditioning effects.

Post-isolation scores showed no significant differences among the various subgroups, although the scores of the Cubicle subjects dropped slightly and those of the Control subjects rose slightly.

Analysis of the number of adjectives and adverbs recalled at the end of the conditioning procedures showed only that higher GT subjects retained more than lower GT subjects.

Table 22

Mean Conditioning Scores of Cubicle and Control Subjects Who Incorrectly Identified Purpose of Conditioning Procedure

GT	Cubicle Subjects				Control Subjects			
	N	Mean	Combined Mean	Mean of Combined Mean	*N*	Mean	Combined Mean	Mean of Combined Mean
High								
Target	12	2.0	1.6		8	.6	1.2	
Nontarget	9	1.2			10	1.8		
Low								
Target	11	3.7	3.7		9	−.9	−.2	
Nontarget	13	3.7			11	.5		
Mean of Combined Mean				2.7				.5

Table 23

Analysis of Mean Conditioning Scores of Cubicle and Control Subjects Who Incorrectly Identified Purpose of Conditioning Procedure

Source	*df*	*MS*	*F*	*p*
Hiigh GT vs. Low GT (A)	1	1.95	.13	
Target vs. Nontarget (B)	1	4.13	.27	
Cubicle vs. Control (C)	1	92.62	6.01	.025
A x B	1	.83	.06	
A x C	1	64.87	4.21	.05
B x C	1	14.92	.97	
A x B x C	1	.59	.04	
Error	75	15.40		

Further analyses indicated that the conditioning effects were confined, as intended, to the evaluative dimension of semantic response.

DISCUSSION

The major finding of this study is that Cubicle subjects, particularly those of lower GT level, are more susceptible than Control subjects to the conditioning procedures and show greater changes in attitude in the intended direction when they do not see that an attempt is being made to influence their attitudes. Cubicle subjects who interpret the conditioning procedures correctly are likely to show some resistance to its effects.

The increased conditionability of the Cubicle subjects is evidently a result of isolation. It is not clear, however, why the effect does not persist. After isolation the mean conditioning scores of all groups were about the same.

Verbal factors can complicate or otherwise obscure the effects of conditioning procedures on human subjects (Kimble, 87). In this study, the post-isolation conditioning scores of the insightful Cubicle subjects were much like those of the noninsightful Cubicle subjects and also significantly greater than zero. This suggests that during isolation the effects of conditioning may have been suppressed and that after isolation, when the subjects' negative responses to the source of the message had been dissipated, the effects became evident. Although nearly two-thirds of the subjects had positive conditioning scores, thus showing some effect in the intended direction, only 9% of the Cubicle and 14% of the Control subjects felt that the conditioning trials had made them think differently about the two national groups.

It is not clear why there was no difference in the numbers of adjectives and adverbs recalled by the Cubicle and Control subjects, since the factors that facilitated conditioning in the Cubicle subjects could be expected to facilitate more cognitive kinds of learning as well.

SUMMARY ON CONDITIONING OF CONNOTATIVE MEANING

In an attempt to modify the attitudes of subjects toward certain national groups, a conditioning procedure was followed that conditioned the common connotative meaning of a series of descriptive words to the name of a national

group. The procedure used was one developed by Staats and Staats on the basis of experimental and theoretical work done earlier by Osgood and his associates.

When initial and final attitudes were taken fully into account, the less intelligent Cubicle subjects were found to be the most susceptible to conditioning. Correct identification of the purpose of the conditioning procedure was also a significant factor: Cubicle subjects who did not identify the purpose correctly and Control subjects who did were the most susceptible to conditioning. Among the former, the less intelligent were the most susceptible. These differential effects did not persist after isolation. The conventional cognitive learning experiment in which the conditioning procedure was embedded produced equal effects on both Cubicle and Control subjects. Those components of the cubicle experience that appear to enhance conditioning seem to have, if anything, an inhibiting effect upon more cognitive learning.

Chapter 11

SUMMARY OF FINDINGS

In each of the experiments described, the behavior of some 30 or more experimental Cubicle subjects was contrasted with that of a like number of Control subjects. In the course of the entire research program, these two classes of subjects were compared with respect to their experiences as subjects (through their retrospective reports and subjective reactions), their reported visual sensations, their ability to perform a vigilance task, their level of intellectual efficiency at solving various types of problems, their susceptibility to being influenced by a group, by propaganda, and by conditioning through word meaning, and their reactions to various forms of stimulation. In addition, observations were made of the time orientation, the restlessness, and the diurnal cycling of the activity of the Cubicle subjects.

SUMMARY OF RESEARCH

Marked differences were found between the subjective reports and the retrospective questionnaire responses made by Cubicle and Control subjects. Both during confinement and immediately afterwards, the cubicle experience was rated by the Cubicle subjects as one of great subjective stress. They reported that it produced severe boredom, great restlessness, disorientation in time, extremely vivid spontaneous visual imagery, and a blurring of the boundaries between sleep and wakefulness and between reality and irreality.

They also reported that during isolation their emotional lives were dominated by many irrational fears, by anger, and by vague physical symptoms, while positive feelings of well-being were almost completely absent. They found their thinking to be inefficient and aberrant; they could not concentrate or carry through a line of thought and they noted alterations in their body schemata. Control subjects rarely reported having any of these experiences over the same period of time.

One-third of the Cubicle subjects requested release from isolation before the end of the 4-day period. They gave a variety of reasons for seeking an early release, such as having become very nervous or feeling that silence or darkness was bearing in on them. Some of them were manifestly quite upset, but all of them readily returned to normal conditions and pursuits.

Visual sensations. Subjects were asked to report visual sensations that appeared out in front of them while they were lying on their beds with their eyes open. Those who had been isolated for three days frequently reported visual scenes of striking realism and complexity. However, Control subjects placed in a darkened test room for just the minimum period of an hour required to take the test reported visual sensations of comparable frequency and complexity. Thus, even a brief period in a totally dark environment appears to be enough to produce impressively vivid visual experiences.

At the end of the isolation period, the Cubicle subjects reported a greater and more elaborate accumulation of visual sensations than did the Control subjects, who had spent little more than the normal amount of time in the dark. It is apparent, however, that over as much as three days, at least, this accumulation of visual experience has no effect upon either the frequency, the vividness, or the complexity of the visual sensations experienced at any one time, as for example during the special test.

The rate at which such experiences take place seems to rise to its maximum level within a relatively short time after the subject is placed in the dark and to remain substantially unchanged through several days of darkness. Whether such visual experiences become frightening or stressful to the subject, or even serve him as entertaining diversion, however, seems to depend upon factors within the individual that have not yet been identified.

Vigilance. On a simple vigilance test to find out how isolation might affect alertness, the Cubicle subjects contrary to expectation had faster reactions to the test tones and also missed fewer signals.

Thus, it appears that the minimal stimuli associated with a simple vigilance task are better able to command and maintain the interest and attention of isolated subjects than of normally active Control subjects. This finding is the most striking indication that performance is not simply degraded in varying degrees by sensory deprivation and social isolation but that, on the contrary, it may be facilitated, at least in simpler tasks.

Intellectual performance. The effects of isolation upon intellectual performance were measured by a battery of brief auditory tests of such things as memory span, numerical facility, verbal fluency, numerical manipulation, and inductive reasoning. The more demanding and complex tasks in the battery—problem solving through induction and successive mental subtractions—found the Cubicle subjects at a disadvantage. However, their level of skill in such simple numerical operations as adding numbers and thinking of words beginning with a given letter seemed to be unaffected by isolation, while their immediate memory spans seemed to be slightly improved. Intellectual efficiency, at least for brief auditory tasks, may apparently be affected in various ways by isolation, depending upon the nature of the performance required.

The absence of consistent and sizable impairment effects during isolation contrasts with the opinion of the Cubicle subjects that their thinking and concentration were impaired. This suggests that the subjects' feelings of inefficiency stem from their placing a greater premium on the more complex types of performance. Since these verbal reports of inefficiency appear to reflect judgments of performances more complex than those sampled in the brief experimental tests, they cannot be discounted.

Susceptibility to influence. Experiments concerning the relative extent to which Cubicle subjects can be influenced by judgments made by other members of a supposed group and by propaganda material yielded rather complex results. The responses made in these situations appear to be moderated by factors such as intelligence and the attitudes of the participating subject toward the testing situation. There is some evidence, however, that the Cubicle subject, particularly the less intelligent one, may be more readily influenced in his behavior than the Control subject. This appears to be especially clear on a learning task, in which evaluative meanings of words were more readily conditioned to initially neutral words during experimental isolation than during normal control life.

Reaction to stimulation. Cubicle subjects requested repeated hearings of a single recorded message even when the information it carried was contrary to

their initial attitudes. No enhanced desire for stimulation was shown when the commodities available upon request were simple tones and white noise, although this may have been in part a function of the testing methods used. In fact, one consistent finding was that when each pull of a lever was followed by seven seconds of silence, Cubicle subjects worked harder than Control subjects to turn off white noise.

This may bespeak greater irritability for the isolated subjects, perhaps akin to his reportedly heightened sensitivity to pain. Or it may be direct evidence of a mode of adjustment to isolation called "encapsulation," in which the subject builds himself a psychological cocoon as a shield against such reminders of the normal world as test stimuli and voices, in order to help him withstand his period of impoverished stimulation.

The phenomenon has been described in autobiographical accounts by war prisoners placed in solitary confinement, although one may well question the representativeness of such accounts. If encapsulation does occur, the subject of a sensory deprivation experiment must truly be in conflict between the heightened excitement produced by even inane test stimuli and regrets about their occurrence as token reminders of the normal world.

In summary, there is clear evidence that informative stimuli are more desired under conditions of sensory deprivation and that they exert a somewhat greater impact than they normally would. Less clearly supported is the hypothesis that in isolation normally irritating stimuli may become more irritating, or possibly that an encapsulation reaction may occur as a means of rendering a stimulus-poor environment more tolerable.

Activity patterns. Finally, the pattern of life-sustaining activities, the pattern of restlessness, and changes in the time orientation of Cubicle subjects were also observed. Retrospective reports had highlighted the importance of these factors.

Life-sustaining activities and restlessness showed a clear diurnal cycle throughout the four days, with greater activity during the daytime. This diurnal pattern contrasts strikingly with the common report of subjects that their habits of sleep became disrupted, particularly during the last two days of life in the unchanging environment of the virtually soundproof cubicle. More consistent with the subjective reports was the finding that daytime restlessness increased sharply on each successive day of the 4-day period. In a monotonous environment there is apparently a progressive buildup, over time, of tension and restlessness.

Against taking these data as evidence of an internal biological clock, however, it should be noted that food eaten just before isolation could well lead to several days of regularity.

The prominence given to tedium and restlessness in the descriptions of cubicle life suggested that these factors might be associated with requests for early release from the cubicle environment. Not only did tedium and restlessness prove to be good predictors of early release, but their extent further predicted, within the early release group, how soon the request would occur.

Thus, the more a Cubicle subject overestimated the passage of time (indicating a dragging out of time) the more likely he was to withdraw from the cubicle and the earlier he was likely to request release. Similarly, the level of restlessness shown by a subject on the second day of isolation was significantly related to his requesting early release, and the more restless he was, the sooner his request would come.

While these findings provide no formula for selecting men for duty in monotonous surroundings, they do shed light on the role of time orientation and restlessness in tolerance of sensory monotony, and suggest types of variables that might be measured before making such an assignment. Certainly, attempts to predict isolation tolerance with standard personality measures have yielded very little so far.

CONCLUSIONS

From these studies it can be concluded that four days of sensory deprivation and social isolation produce the following effects:

(1) Subjective stress, severe boredom and restlessness, disorientation in time, dimming of the boundaries of sleep and reality, unrealistic fears, worry and anger, perceived inability to concentrate and think, alterations of the body schema, and vague physical symptoms.

(2) Frequent and complex visual sensations. While these sensations do not increase in either frequency or intensity as isolation is prolonged, they nevertheless do have a cumulative effect during lengthy waking periods in the dark. These sensations sometimes appear to be uncontrollable and frightening to subjects in isolation.

(3) Some impairment of intellectual function in more complex tasks but also some facilitation in such simple tasks as vigilance.

(4) Increased susceptibility to influence, particularly on a task in which connotative meanings were conditioned to previously neutral words.

(5) A greater desire to hear information even when it is contrary to initial belief and some indication of possible greater irritability or overreactivity to mildly noxious stimuli.

(6) Progressive increases in restlessness superimposed upon a clear-cut diurnal cycle of both restlessness and life-supporting activity. The degree of tedium and restlessness shown by a subject early in isolation predicts his subsequent tolerance of sensory deprivation, as measured both by the likelihood of his requesting early release, and by the latency of his request.

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Appendix A

SUPPLEMENTARY DATA ON PERSONAL CHARACTERISTICS

Table A-1

Significance Levels for Differences Between Volunteers (V) and Nonvolunteers (NV) on Background and Personal Characteristics[a]

Variable	Data Period I		Data Period II		I & II	
	V (N=245)	NV (N=109)	V (N=136)	NV (N=30)	N (N=381)	NV (N=139)
Age		.001				.05
Percent draftees		.01				.05
Percent single			.20			
Percent beyond high school					.11	
Number of siblings	.20					
Both parents at home				.20		.17
Percent first born						
Percent smokers						
IPIT score	.05					
GT score						
CI score	.02		.10		.005	
MMPI						
Hs		.10				.13
D		.01				.03
Hy		.01				.09
Pd		.01		.10		.005
Mf						
Pa				.20		
Pt		.10				.08
Sc						
Ma				.20		
Si						
L						
F						
K					.14	
EPPS						
Achievement			.20			
Deference	.05			.20		
Order						
Exhibition						
Autonomy						
Affiliation						
Intraception						
Succorance				.10		
Dominance						
Abasement						
Nurturance						
Change	.10		.30		.06	
Endurance	.05				.12	
Heterosexuality			.20			
Aggression		.20		.01		.01
Consistency		.05				

[a]For each comparison the probability is in the column of the group with the higher value.

Table A-2

Significance Levels for Differences Between Long-Staying (LS) and Early Release (ER) Subjects on Background and Personal Characteristics[a]

Variable	Data Period I		Data Period II		I & II	
	LS (N=77)	ER (N=35)	LS (N=29)	ER (N=27)	LS (N=106)	ER (N=62)
Age	.20		.05		.03	
Percent draftees						
Percent single				.10		
Percent beyond high school			.05		.17	
Number of siblings	.20					
Both parents at home		.20	.20			
Percent first born						
Percent smokers		.01				.03
IPIT score						
GT score						
CI score						
MMPI						
Hs						
D	.20			.10		
Hy				.02		.14
Pd		.10		.05		.02
Mf						
Pa						
Pt						
Sc						
Ma		.10				.06
Si						
L						
F				.20		
K						
EPPS						
Achievement						
Deference	.01		.10		.005	
Order						
Exhibition		.10				.11
Autonomy						
Affiliation	.05				.10	
Intraception						
Succorance			.20			
Dominance		.20				
Abasement						
Nuturance						
Change						
Endurance						
Heterosexuality						
Aggression		.02				.17
Consistency			.20		.11	

[a]For each comparison the probability is in the column of the group with the higher value.

Appendix B

SUPPLEMENTARY DATA ON THE RETROSPECTIVE QUESTIONNAIRE

Table B-1

Significance Levels for Differences Between Cubicle and Control Subjects on Retrospective Questionnaire[a]

Content Area	Data Period I		Data Period II		I & II	
	Cubicle (N=115)	Control (N=116)	Cubicle (N=56)	Control (N=82)	Cubicle (N=171)	Control (N=198)
Reported visual sensations	.001		.001		.001	
Dreams	.001		.001		.001	
Reminiscence and memory	.001		.001		.001	
Sex	.001		.10		.001	
Novelty and surprise	.001		.001		.001	
Speech difficulties	.001		.001		.001	
Army assignment		.05	.80			>.20
Self-appraisal	.001		.01		.001	
Inefficiencies of thought	.001		.001		.001	
Loss of touch with reality	.001		.001		.001	
Attitude toward monitor and tests	.20		.01		.01	
Religion		.70	.10		>.20	
Lonesomeness	.001		.001		.001	
Hunger	.001		.001		.001	
Tedium of time passage	.001		.001		.001	
Temporal orientation	.001		.001		.001	
Subjective restlessness	.001		.001		.001	
Restless acts	.001		.01		.001	
Anger	.001		.001		.001	
Regret participation	.001		.001		.001	
Worry and fright	.001		.001		.001	
Feelings of well-being		.001		.001		.001
Body image change	.001		.001		.001	

[a]For each comparison the probability is in the column of the group with the higher value.

Table B-2

Significance Levels for Differences Between Long-Staying (LS) and Early Release (ER) Subjects on Retrospective Questionnaire[a]

Content Area	Data Period I		Data Period II		I & II	
	LS (N=83)	ER (N=36)	LS (N=29)	ER (N=27)	LS (N=112)	ER (N=63)
Reported visual sensations						
Dreams						
Reminiscence and memory	.20		.05		.05	
Sex			.10		.06	
Novelty and surprise						
Speech difficulties						
Army assignment	.10					
Self-appraisal	.10					
Inefficiencies of thought		.10		.10		.05
Loss of touch with reality		.10				.06
Attitude toward monitor and tests		.20				
Religion						
Lonesomeness				.02		.05
Hunger	.10				.15	
Tedium of time passage		.001		.01		.001
Temporal orientation		.001		.001		.001
Subjective restlessness		.05		.001		.001
Restless acts						
Anger	.10				.18	
Regret participation						
Worry and fright		.01		.02		.001
Feelings of well-being	.001		.02		.001	
Body image change		.02				.09

[a]For each comparison the probability is in the column of the group with the higher value.

Appendix C

SUPPLEMENTARY DATA ON INTELLECTUAL PERFORMANCE TESTS

Table C-1

Characteristics of Five Tests of Intellectual Performance

Test	Score	Approximate Test Time (min.)	Split-Half Reliabilities[a]			Test-Retest Reliabilities (4-day interval)		
			Form	*N*	*r*	Forms	*N*	*r*
Immediate memory	Number	10	I	110	.77	I, I	34	.86
(Digit Span Test–forward	of		I	140	.78	I, I	20	.63
digit span series, 5 items	errors					I, I	34	.61
each from series lengths						I, I	19	.70
5 through 10, presented								
in a scrambled order).								
Verbal fluency	Number	4	T	72	.82			
(Verbal Fluency Test–	of		T	71	.82	T, T	50	.66
number of words begin-	words		M	70	.82	T, M	31	.44
ning with a given letter			T	72	.77			
spoken in a 3-minute			M	45	.80			
period).			T	45	.80			
Numerical facility	Median	7	I	72	.84	I, II	15	.90
(Mental Arithmetic Test–	latency		II	69	.94	I, II	15	.86
mentally adding two 2-digit						II, I	19	.84
numbers; 10 problems).						II, I	19	.81
Inductive reasoning	Median	20	I	72	.83	I, II	15	.60
(Coins Test–specify num-	latency		II	68	.86	I, II	15	.77
ber and denomination of						II, I	19	.93
coins such that given						II, I	19	.79
number of coins adds up								
to given amount; 14								
problems).								
Successive subtraction	Total	2	Not applicable			I, I	15	.82
(Series 7 Test– successively	time					I, I	15	.47
subtract 7 from a starting						I, I	19	.75
value of 100).						I, I	19	.55

[a]Split-half (odd-even) items; alternate 30-second time intervals in the verbal fluency test are corrected by the Spearman-Brown formula. Separate estimates were obtained for alternate test forms and testing conditions (light room, dark room, etc.).

Table C-2

Numbers of Subjects Who Took Each Test of Intellectual Performance

Test	Test Situation			
	Pre-Isolation		During-Isolation	
	Light	Dark	Cubicle	Control
Immediate memory	139	111	54	53
Verbal fluency	233	142	85	85
Numerical facility	68	72	34	34
Inductive reasoning	68	82	34	34
Successive subtraction	70	71	34	34

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13. ABSTRACT

To evaluate experimentally some of the psychological effects of sensory deprivation and social isolation, 176 randomly selected volunteers were placed in dark, soundproofed cubicles for four days, while an equal number of other randomly selected volunteers followed a normal routine. Psychological tests and measures were given both Cubicle and Control subjects before, during, and after isolation. Cubicle subjects reported the isolation experience to be unpleasant, boring, and stressful. One-third of them requested early release from the cubicles. In comparison with the Control subjects, Cubicle subjects were better on simple intellectual tasks and on auditory vigilance. They were worse on more complex intellectual tasks, and under some conditions, appeared to be more susceptible to influence. They more often sought meaningful stimulation but also showed some tendency to avoid stimulation. Sensory deprivation and social isolation do have psychological effects, but they are neither simple nor clear-cut.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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2 CG EIGHTH ARMY APO 301 SAN FRAN ATTN G3
1 CLIN PSYCHOL SERV DEPT OF NEUROPSYCHIAT WALTER REED GEN HOSP
1 DIR HUMAN ENGNR LABS ABERDEEN PG
2 ENGNR PSYCHOL LAB PIONEERING RES DIV ARMY NATICK LABS NATICK MASS
4 TECH LIB ARMY NATICK LABS NATICK MASS
3 CO ARMY CHEM R+D LABS EDGEWOOD ARSNL MD ATTN LIBN
1 CG US ARMY MSL COMD REDSTONE ARSNL
1 CO ARMY PICTORIAL CTR LONG ISL ATTN APPLICAT DEVEL BR TV DIV
1 CG ARMY ELEC PG FT HUACHUCA ATTN TECH LIB
12 CO 1ST AIR DEF GUIDED MSL BRGD TNG FT BLISS
1 CG ARMY CBT DEVEL COMD EXPRM CTR FT ORD
1 SIXTH ARMY LIB DEPOT PRES OF SAN FRAN
1 CHF DEPT OF CLIN + SOC PSYCHOL WALTER REED ARMY INST OF RES
WALTER REED ARMY MED CTR
5 CG FT ORD ATTN G3 TNG DIV
1 CO DUGWAY PG UTAH ATTN TECH LIB
1 DIR WALTER REED ARMY INST OF RES WALTER REED ARMY MED CTR
1 DIR WALTER REED ARMY INST OF RES WALTER REED ARMY MED CTR
ATTN NEUROPSYCHIAT DIV
1 CO HQ ARMY ENLISTED EVAL CTR FT BENJ HARRISON
1 DPTY FOR BIOASTRONAUT PG AIR PG CTR EGLIN AFB
1 CO FRANKFORD ARSNL ATTN SMUFA 1031/65-I
2 WALTER REED ARMY INST OF RES ATTN DEPT OF PSYCHIAT NEUROPSYCHIAT DIV
1 CG 5TH RGN USARADCOM FT SHERIDAN ATTN G3 TNG
3 6TH RGN USARADCOM FT BAKER
2 11TH AIR ASSAULT DIV FT BENNING
1 FIRST ARMY MSL COMD MED APO 221 NY
2 CO PICATINNY ARSNL DOVER N J ATTN SUMPA VCI
1 DEF SUPPLY AGY CAMERON STATION ATTN LIB
1 CO ARMY CBT DEVEL COMD FT BENJ HARRISON ATTN ADJ GEN AGY
1 CBT OPNS RES GP ARMY CBT DEVEL COMD FT BELVOIR
ATTN OPNS ANLS HUMAN FACTORS
1 CO ARMY CBT DEVEL COMD FT BENNING ATTN INF AGY
1 CO ARMY CBT DEVEL COMD FT KNOX ATTN ARMOR AGY
8 ARMY CBT DEVEL COMD FT BRAGG ATTN SPEC WARFARE AGY
1 EVAL DIV DAO ARMY SIG CTR + SCH FT MONMOUTH
1 CHF CURRICULUM BR RESIDENT INSTR DEPT ARMY LOGISTICS MANGT CTR FT LEE
3 CO ARMY CBT DEVEL COMD SPEC DOCTRINE + EQUIPMENT GP FT BELVOIR
3 CIVLN PERS OFCR US ARMY SPT CTR ST LOUIS ATTN EMPLOYEE DEVEL OFCP
3 ARMY WAR COLL CARLISLE BKS ATTN LIB
1 ASST COMDT ARMY INTEL SCH FT HOLABIRD ATTN PLANS DIV DAO
1 COMDT CGMD + GEN STAFF CO FT LEAVENWOPTH ATTN ARCHIVES
1 DIR OF MILIT PSYCHOL + LDRSHP US MILIT ACAD WEST POINT
1 US MILIT ACAD WEST POINT ATTN LIB
1 COMDT ARMY AVN SCH FT RUCKER ATTN SCH LIB
2 COMDT ARMY SECUR AGY TNG CTR + SCH FT DEVENS ATTN LIB
1 COMDT ARMED FORCES INDSTN COLL FT LESLEY J MCNAIR
2 COMDT NATL WAR COLL FT LESLEY J MCNAIR ATTN CLASSF RECORDS BR LIB
1 MED FLD SERV SCH BROOKE ARMY MED CTR FT SAM HOUSTON ATTN STIMSON LIB
5 DIR OF INSTR ARMOR SCH FT KNOX
1 COMDT ARMY ARMOR SCH FT KNOX ATTN WEAPONS DEPT
1 COMDT ARMY CHAPLAIN SCH FT HAMILTON
1 COMDT ARMY CHEM CORPS SCH FT MCCLELLAN ATTN EDUC ADV
1 ARMY FINANCE SCH FT BENJ HARRISON
4 COMDT ARMY ADJ GEN SCH FT BENJ HARRISON ATTN EDUC ADV
1 ARMY INF SCH FT BENNING ATTN EDUC ADV
1 ARMY QM SCH FT LEE ATTN LIB
1 COMDT ARMY QM SCH FT LEE ATTN EDUC ADV
1 COMDT ARMY TRANS SCH FT EUSTIS ATTN EDUC ADV
1 COMDT ARMY MILIT POLICE SCH FT GORDON ATTN DIR OF INSTR
1 COMDT ARMY SOUTHEASTERN SIG SCH FT GORDON
1 CG ARMY ORD CTR + SCH ABERDEEN PG ATTN AISO-SL
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4 CG ARMY ARTY + MSL CTR FT SILL ATTN AVN OFFR
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2 COMDT US ARMY SCH EUROPE APO 172 NY ATTN REF LIB
1 CHF POLICY + TNG LIT DIV ARMY ARMOR SCH FT KNOX
1 COMDT ARMY PRIMY HEL SCH FT WOLTERS
1 DIR OF MILIT INSTR US MILIT ACAD WEST POINT
1 SPEC WARFARE SCH FT BRAGG ATTN LIB
1 COMDT ARMY MANGT SCH FT BELVOIR
2 SECY ARMY ORDNANCE GUIDED MISSILE SCH REDSTONE ARSNL
2 COMDT WOMENS ARMY CORPS SCH + CTR FT MCCLELLAN
2 HQ ABERDEEN PG ATTN TECH LIB
1 COMDT ARMY QM SCH DFC DIR OF NONRESID ACTVY FT LEE ATTN TNG MEDIA DIV
2 DIR BRGD + BN OPNS DEPT USAIS FT BENNING
1 MED FLD SERV SCH BROOKE ARMY MED CTRFT SAM HOUSTON DERT OF NEUROPSYCHIAT
2 DIR COMPANY TACTICS DEPT USAIS FT BENNING
1 SECY OF ARMY
1 OCS-RERS DA ATTN CHF C+S DIV
2 OACS FOR INTEL DA ATTN CHF CBT INTEL DEVEL DIV
2 AGS FOR FORCE DEVEL DA ATTN CHF TNG DIV
1 CHF OF ENGNRS DA ATTN ENGTE-T
1 HQ ARMY MAT COMD R+D DRCTE ATTN AMCRD-RC
1 CHF OF PERS OPNS OFCR PERS DRCTE DA ATTN SIG BR
1 CLIN PSYCHOL CONSLT OFC OF CHF PSYCHIAT + NEURDL CONSLT OFC OF SURG GEN
ATTN LT COL MSC
2 CG ARMY MED R+D COMD ATTN BEHAV SCI R@S BR

1 ARMY PERS RES OFC ATTN CRD-AR
2 OFC OF PERS OPNS DA ATTN OPOSS-A
1 STANDARDS + SYS OFC OPD OCCUP R+D SECT ATTN OPDSS-A
1 ARMY PROVOST MARSHAL GEN
1 DIR CIVIL AFFAIRS DRCTE DOCS-OPNS DA
1 OFC RESERVE COMPON DA
2 CHF ARMY SECUR AGY ARLINGTON HALL STA ATTN ACS-G1
2D CDR DEF DOCUMENTATION CTR CAMERON STA
1 CG ARMY ELECT COMD FT MONMOUTH ATTN AMSEL CB
1 CHF OF R+D DA ATTN CHF TECH + INDSTR LIAISON OFC
1 EDUC + TNG BR CBT DEVEL + OPNS DIV OFC OF CHF SIG OFFR DA
1 PERS + TNG DIV ORDHC OFC OF CHF OF ORD DA
2 CG ARMY MED R+D COMD ATTN MEDDH-SR
1 ARMY PERS RES OFC ATTN CRD-AIC
1 COMDT ARMY CBT SURVEIL SCH FT HUACHUCA ATTN ATSUR S3
1 CG ARMY AIR DEF COMD ENT AFB
1 PRES ARMY INF BD FT BENNING ATTN FE+SP DIV
1 PRES ARMY MAINT BD FT KNOX
2 PRES ARMY ARTY BD FT SILL
1 OPTY RRES ARMY MAT COMD BD ABERDEEN PG
1 PRES ARMY TRANS BD FT EUSTIS
1 CO ARMY CBT DEVEL COMD MILIT POLICE AGY FT GORDON
1 OFC OF SURG 1ST ARMORED DIV FT HOOD
1 CG 2D ARMORED DIV FT HOOD ATTN DIV AVN OFCR
3 CG 4TH ARMORED DIV APO 326 NY
2 CO 16TH ARMOR GP FT IRWIN
4 CO 2D ARMORED CAV REGT APO 696 NY
1 CO 3D ARMORED CAV REGT APO 34 NY
6 CO 11TH ARMORED CAV REGT APO 305 NY
1 CO 14TH ARMORED CAV REGT APO 26 NY
2 CG ARMY ARMOR + ARTY FIRING CTR FT STEWART ATTN ACS-G3 TNG OFCR
1 1ST ARMORED DIV HQ+HQ CO FT HOOD ATTN ACS-G2
5 1ST INF DIV 1ST MED TANK BN 63D ARMOR FT RILEY
7 3D INF DIV 1ST BN 64TH ARMOR APO 36 NY
2 CDR 1ST BN 34TH ARMOR FT LEWIS
8 8TH INF DIV 2D BN 68TH ARMOR APO 34 NY
1 CO COMPANY A 3D BN 32D ARMOR 3D ARMORED DIV (SPEARHEAD) APO 39 NY
1 CO 5TH BN 33D ARMOR FT KNOX
1 CO 3D MED TANK BN 68TH ARMOR APO 2R NY ATTN S3
1 CO 3D MED TANK BN 37TH ARMOR APO 36 NY
1 CO 4TH MED TANK BN 68TH ARMOR APO 28 NY
6 CO 2D BN 34TH ARMOR FT IRWIN
2 CALIF NG 40TH ARMORED DIV LOS ANGELES ATTN ACS-G3
1 55TH COMD HQ DIV ARMY NG JACKSONVILLE FLA
1 CG HQ 27TH ARMORED DIV NY AIR NG SYRACUSE
1 TEXAS NG 49TH ARMORED DIV DALLAS
6 CO 3D MED TANK BN 32D ARMOR APO 29 NY
1 CG ARMY ARMOR CTR FT KNOX ATTN G3 AIBKGT
2 CG 1ST INF DIV FT RILEY ATTN G3
1 CG 2D INF DIV FT BENNING ATTN DIV AVN COMDR
3 CG 4TH INF DIV FT LEWIS ATTN G3
1 CG 8TH INF DIV APO 111 NY ATTN G2
1 CG 5TH INF DIV (MECH) FT CARSON
5 CG 24TH INF DIV APO 112 NY ATTN G3
1 CG HQ US ARMY HAWAII APO 957 SAN FRAN ATTN G2
3 CG B2D ABN INF DIV FT BRAGG ATTN G3
1 CO 1ST BN (RFINFT 3D INF (THE OLD GUARD) FT MYER
1 CO HQ 2D BN 6TH INF REGT APO 742 NY
7 CO 3D BN 6TH INF REGT APO 742 NY
1 CO 17IST INF BRGD APO 731 SEATTLE
3 CG 25TH INF DIV APO 25 SAN FRAN
1 CO 4TH BG 30TH INF FT SILL
1 CO 2D BG 31ST INF REGT FT RUCKER
1 CO 3D BN 19TH INF APO 29 NY
1 CO 1ST BN 39TH INF APO 2B NY
5 CO 1ST BN (MECH) 52D INF 1ST ARMORED DIV (OLD IRONSIDES) FT HOOD
7 4TH BN (MECH) 54TH INF FT KNUX
1 CO ARMY PARTIC GP NAV TNG DEVICE CTR PT WASHINGTON ATTN CODF OIA
2 CO HD ARMY BROADCASTING + VISUAL ACTVY PACIFIC APO 331 SAN FRAN
ATTN PUBS PROC OFC
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1 DIR ARMY LIB
1 STRATEGIC PLANNING GR CORPS OF ENGNR ARMY MAP SERV
1 CHF OF MILIT HIST DA ATTN GEN REF BR
1 B2D ABN DIV FT BRAGG
5 HQ 40TH ARTY BRGD AIR DEF PRES OF SAN FRAN
1 CO 56TH ARTY BRGD AIR DEF FT BANKS
1 CG 31ST ARTY BRGD AIR DEF OAKDALE PENNA
1 28TH ARTY GP AIR DEF SELFRIDGE AFB
1 52D ARTY BRGD AIR DEF HIGHLANDS AFS
1 HQ NIAGARA-BUFFALO DEF 31ST ARTY BRGD AIR DEF LOCKPORT
1 HQ 45TH ARTY BRGD AIR DEF ARLINGTON HTS ILL
1 35TH APTY BRGD AIR DEF FT GEO G MEADE
1 CG 101ST ABN DIV FT CAMPBELL
1 CG 1ST CAV DIV APO 24 SAN FRAN
1 ARMY QM R+E FEA FT LEE ATTN TECH LIB
1 CHF BEHAV SCI RFS BR ARMY MED R+D COMD
2 PRES ARMY FINANCE CORPS BR
1 ARMY R+D OFC PANAMA FT CLAYTON CANAL ZONE ATTN BEHAV SCI COORD
1 CO ARMY RES OFC DURHAM
2 CINC US PACIFIC FLT FPO SAN FRAN
1 CINC PACIFIC OPNS ANLS SECT FPO SAN FRAN
1 CHF BUR OF MED + SURG DN ATTN CODE 513
1 CHF RES DIV BUR OF MED + SURG DN
1 HEAD CLIN PSYCHOL SECT PROFESNL DIV BUR OF MED + SURG ON
5 BUR OF NAV PERS ATTN TECH LIB PERS 11B
3 DIR PERS RES DIV BUR OF NAV PERS
1 BUR OF YDS + DKS ON ATTN ASST CHF FOR RES DEVEL TEST + EVAL
2 BUR OF NAV WEAPONS FLT READINESS RFR ATLANTIC NAV AIR STATION NORFOLK
1 CO + DIR NAV TNG DEVICE CTR PT WASHINGTON ATTN LIBN
2 NAV MSL CTR POINT MUGU CALIF ATTN HUMAN FACTORS ENGNR DIV
1 CO NAV AIR DEVEL CTR JOHNSVILLE PENNA ATTN NADC LIB
2 CO FLT TNG CTR NAV BASE NEWPORT
2 OIC ATLANTIC FLT MSL WEAPON SYS TNG UNIT FLT ANTI-AIR WARFARE TNG CTR
DAM NECK VA BEACH
1 CDR FLT TNG GP NAV BASE CHARLESTON

2 CO FLT TNG CTR NORFOLK
2 HUMAN FACTORS DEPT COMN PSYCHOL DIV NAV TNG DEVICE CTR PT WASHINGTON
1 CLIN PSYCHOL MENTAL HYGIENE UNIT US NAV ACAD ANNAPOLIS
1 PRES NAV WAR COLL NEWPORT ATTN NAHAN LIB
3 CO SERV SCH COND NAV TNG CTR SAN DIEGO
3 CO NAV GUIDED MSL SCH DAN NECK VA BEACH
2 CO + DIR ATLANTIC FLT ANTI-SUB WARFARE TACTICAL SCH NORFOLK
1 CO NUCLEAR WEAPONS TNG CTR ATLANTIC NAV AIR STA NORFOLK
2 CO FLT ANTI-AIR WARFARE TNG CTR DAN NECK VA BEACH
2 CO FLT SONAR SCH KEY WEST
1 CHF OF NAV RES ATTN HEAD PERS + TNG BR CODE 458
1 CHF OF NAV RES ATTN DIR PSYCHOL SCI DIV CODE 45D
1 CHF OF NAV RES ATTN HEAD GP PSYCHOL BR CODE 452
1 DIC NAV PERS RES ACTVY NAV YD WASHINGTON
5 CO OFC OF NAV RES BR OFC FPO 39 NY
1 CHF OF NAV AIR TNG TNG RES DEPT NAV AIR STA PENSACOLA
1 CO NAV SCH OF AVN MED NAV AVN MED CTR PENSACOLA
1 NAV MED RES LAB NAV SUB BASE GROTON ATTN LIB
1 CO MED FLD RES LAB CAMP LEJEUNE
1 CDR NAV MSL CTR POINT MUGU CALIF ATTN TECH LIB CODE 3D22
3 DIC NAV PERS RES ACTVY SAN DIEGO
1 NAV AIR TECH TNG CTR MEMPHIS
1 NAV NEUROPSYCHIAT RES UNIT SAN DIEGO
1 DIC NAV PERS RES ACTVY NAV STA NAV YD ANNEX WASHINGTON
1 CONTRL NAV BASE NORFOLK
1 COMDT MARINE CORPS HQ MARINE CORPS ATTN CODE AO-1B
1 HQ MARINE CORPS ATTN AX
1 DIR MARINE CORPS EDUC CTR MARINE CORPS SCH QUANTICO
ATTN SECRET + CONF FILES GP
1 OIR MARINE CORPS INST ATTN EVAL UNIT
1 CHF OF NAV OPNS OP-01P1
1 CHF OF NAV OPNS OP-07T2
1 CHF OF NAV AIR TECH TNG NAV AIR STA MEMPHIS
2 COMDT PTP COAST GUARD HQ
1 CHF OFCR PERS RES + REVIEW BR COAST GUARD HQ
1 OPNS ANLS OFC HQ STRATEGIC AIR COND OFFUTT AFB
1 CINC STRATEGIC AIR COND OFFUTT AFB ATTN SUP-3
1 AIR TNG COND RANDOLPH AFB ATTN ATFTM
3 DIR OF PERS PROCUR + RETENTION AIR FORCE NILIT PERS CTR RANDOLPH AFB
1 HQ AIR FORCE ATTN AFCIN-3D1
1 CHF SCI DIV DRCTE SCI + TECH OCS R+D HD AIR FORCE AFRSTA
1 CHF SPEC WARFARE DIV DRCTE OF PLANS + OPNS DCS-PLANS+OPNS
HQ AIR FORCE
1 CHF OF PERS RES BR DRCTE OF CIVILIAN PERS DCS-PERS HD AIR FORCE
1 CHF EVAL BR(AFPDPCE) CAREER DEVEL DIV DRCTE OF PERS PLAN HD AIR FORCE
1 SUBSIQ PLANS DIV DRCTE OF PLANS DCS-PLANS + PROG HD AIR FORCE
2 DPTY INSPECTOR GEN AIR FORCE (AFIAS-GI) NORTON AFB
1 CHF CONN STUDY GP SAFDIXD BOLLING AFB STOP B-2D
1 FED AVN AGY MED LIB HD-640
1 HD AIR FORCE STAFF COLL SCGB 3 ANDREWS AFB
1 RDME AIR DEVEL CTR RASH GRIFFISS AFB
2 CDR ELEC SYS DIV L G HANSCOM FLD BEDFORD MASS ATTN ESRHD
2 SACRAMENTO AIR MAT AREA SMACU-PERS RES MCCLELLAN AFB
1 AIR TNG COND ATTWS W RANDOLPH AFB
1 AERO MED RES LAB NRPTD WRIGHT-PATTERAIR MOVEMENT DESIGNATOR NRPTD WRIGHT
1 HD BALLISTICS SYS DIV PERS SUBSYS BR BSDSP NORTON AFB
2 MILIT TNG CTR OPE LACKLAND AFB
2 6570TH AERO MED RES LAB NRPT WRIGHT-PATTERSON AFB
1 AIR MOVEMENT DESIGNATOR AMRH BROOKS AFB
1 DCS-TECH TNG DIR MILIT + SPT TNG RANDOLPH AFB
2 HD AIR TRANS COND ATCTD-N RANDOLPH AFB
1 COR ELEC SYS DIV LG HANSCOM FLD ATTN EST1
1 DIR AIR U LIB MAXWELL AFB ATTN AUL3T-63-253
1 AIR FORCE SCH OF AEROSPACE MED BROOKS AFB ATTN AERDMED LIB
1 DIR OF LIB US AIR FORCE ACAD
1 DRCTE OF AEROSPACE SAFETY AFIAS-L OPTY 1G NORTON AFB
1 COMDR ARCTIC AERDMED LAB APO 731 SEATTLE
1 6570TH PERS RES LAB PRA-4 AEROSPACE MED DIV LACKLAND AFB
1 DIR NATL SECUR AGY FT GED G MEADE ATTN DIR OF TNG
3 CENTRAL INTEL AGY ATTN OCR MAIL RN
1 DEPT OF STATE BUR OF INTEL + RES EXTERNAL RES STAFF
1 SCI INFO EXCH WASHINGTON US INFO AGY IR1 L PROCUREMENT LIB
2 CHF REGL TNG BR TNG DIV FED AVN AGY ATTN PT 3B
1 CHF PERS RES STAFF OFC OF PERS DEPT OF AGRICUL
1 RES INFO CTR NATL BUR OF STANDARDS ATTN RES PSYCHOL
1 CHF PSYCHOL BR CIVIL AERDMED RES INST FED AVN AGY OKLAHOMA CITY
2 SYS DEVEL CORP SANTA MONICA ATTN LIB
1 DUNLAP + ASSOC INC DARIEN ATTN LIB
2 RES ANLS CORP BETHESDA
1 RAND CORP WASHINGTON ATTN LIB
1 U OF ILL GP EFFECTIVE RES LAB
1 U OF SO CALIF ELEC PERS RES GP
1 COLUMBIA U ELEC RES LABS ATTN TECH EDITOR
1 MITRE CORP BEDFORD MASS ATTN LIB
1 WESTERN ELECTRIC CO WINSTON-SALEM
2 U OF PGH LEARNING R+D CTR ATTN DIR
1 HUMAN SCI RES INC NORFOLK
1 WESTERN ELECTRIC CO INC NY
1 HUMAN ECOLOGY FUND WASHINGTON
1 HUMAN SCI RES INC MCLEAN VA
2 TECH INFO CTR ENGNR DATA SERV N ANER AVN INC COLUMBUS O
1 CHRYSLER CORP MSL DIV DETROIT ATTN TECH INFO CTR
1 AVCO CORP LAWRENCE MASS ATTN MANGR HUMAN FACTORS DEPT
1 SDRO AMER U ATTN LIBN
1 RAYTHEON CO ELEC SERV OPNS BURLINGTON MASS
1 EDUC + TNG CONSULTANTS LOS ANGELES ATTN PRINCIPAL SCI
1 INFO SYS DEPT 197 SPACE + INFO SYS DIV N ANER AVN INC DOWNEY CALIF
1 GEN DYNAMICS POMONA CALIF ATTN LIB
1 BELL AEROSYS CO CASTLE AFB
1 AVN CRASH INJURY RES SKY HARBOR AIRPORT PHOENIX ATTN TECH LIBN
2 NARDUAROT CORP POMONA CALIF ATTN DEPT 580
1 CHF PERS SUBSYS AIRPLANE DIV NS 74-9D RENTON WASH
1 SYLVANIA ELECTRIC PRODUCTS INC NEEDHAM HGTS MASS ATTN PERS SUBSYS MANGR

1 THIOKOL CHEM CORP HUNETRICS DIV LOS ANGELES ATTN LIBN
2 SORO FLD OFC OFC OF SECY SPEC WARFARE SCH FT BRAGG
1 DIR OF RELIABILITY + VALUE ENGNR BELL AEROSYS CO BUFFALO
1 INST FOR DEF ANLS RES + ENGNR SUPPORT OIV WASHINGTON
1 HUGHES AIRCRAFT COMPANY CULVER CITY CALIF
1 DIR CTR FOR RES ON LEARNING + TEACHING U OF MICH
1 OHIO STATE U
1 EDITOR TNG RES ABSTR ANER SOC OF TNG DIRS U OF TENN
1 U OF CHICAGO DEPT OF SOC
1 GED WASHINGTON U DEPT OF PSYCHOL
1 DIR SORO AMER U
6 BRITISH EMBSY BRITISH DEF RES STAFF WASHINGTON
3 CANADIAN JOINT STAFF OFC OF DEF RES MEMBER WASHINGTON
3 CANADIAN ARMY STAFF WASHINGTON ATTN GSD2 TNG
2 CANADIAN LIAISON OFCR ARMY ARMOR BD FT KNOX
3 ACS FOR INTEL FOREIGN LIAISON OFCR TO NORWEG MILIT ATTACHE
1 ACS FOR INTEL FOREIGN LIAISON OFCR FOR SWEDISH EMBSY ATTN ARMY ATTACHE
1 NATL INST FOR ALCOHOL RES DSLO
1 FRENCH LIAISON OFCR ARMY AVN TEST BD FT RUCKER
1 AUSTRALIAN EMBSY OFC OF AIR ATTACHE WASHINGTON ATTN T A NAVGN SDON LDR
1 YORK U DEPT OF PSYCHOL
2 AUSTRALIAN EMBSY OFC OF MILIT ATTACHE WASHINGTON
2 U OF SHEFFIELD DEPT OF PSYCHOL
1 MENNINGER FOUNDATION TOPEKA
2 AMER INST FOR RES WASHINGTON
1 AMER INST FOR RES PGH ATTN LIBN
1 COLUMBIA U SCH OF BUS
3 MATRIX CORP ARLINGTON ATTN TECH LIBN
1 ANER TEL+TEL CO NY
1 U OF GEORGIA DEPT OF PSYCHOL
1 OBERLIN COLL DEPT OF PSYCHOL
1 GEN ELECTRIC CO SANTA BARBARA ATTN LIB
1 VITRO LABS SILVER SPRING MD ATTN LIBN
1 TENN VALLEY AUTHORITY KNOXVILLE ATTN LABOR RELATIONS OFCR DIV OF PERS
1 U OF GEORGIA DEPT OF PSYCHOL
1 U OF UTAH DEPT OF PSYCHOL
1 AMER INST FOR RES LOS ANGELES
1 ANER INST FOR RES PALO ALTO CALIF
1 MICH STATE U COLL OF SOC SCI
1 N MEX STATE U
1 ROWLAND + CO HADDONFIELD NJ ATTN PRES
1 NORTRONICS DIV OF NORTHROP CORP ANAHEIM CALIF
1 LING TEMCO VOUGHT INC WARREN MICH ATTN HEAD HUMAN FACTORS
1 AIRCRAFT ARMAMENTS INC COCKEYSVILLE MD
1 AMER MACH + FOUNDRY CO GREENWICH ENGNR DIV STAMFORD CONN
2 OREGON STATE U DEPT OF MILIT SCI ATTN ADJ
1 TUFTS U HUMAN ENGNR INFO + ANLS PROJ
1 AMER PSYCHOL ASSOC WASHINGTON ATTN PSYCHOL ABSTR
1 NO ILL U HEAD DEPT OF PSYCHOL
1 GEORGIA INST OF TECH DIR SCH OF PSYCHOL
1 REPUBLIC AVN CORP FARMINGDALE LONG ISL ATTN SUPERV ENGNR LIB
1 LIFE SCI INC FT WORTH ATTN PRES
1 AMER BEHAV SCI NY
1 INTERNATL INVENTORS CONGRESS CHICAGO
1 SAN DIEGO STATE COLL PUBLIC ADMIN CTR
2 DIR INSTR RESOURCES STATE COLL ST CLOUD MINN
1 COLL OF WM + MARY SCH OF EDUC
1 SO ILLINOIS U DEPT OF PSYCHOL
2 COMMUNICABLE DISEASE CTR DEVEL + CONSULTATION SERV SECT ATLANTA
2 HOWARD RES CORP ARLINGTON
1 NORTHWESTERN U DEPT OF INDSTR ENGNR
1 NY STATE EDUC DEPT ABSTRACT EDITOR AVCR
1 CHF PROCESSING DIV DUKE U LIB
1 U OF CALIF GEN LIB DOCU DEPT
1 FLORIDA STATE U LIB GIFTS + EXCH
1 HARVARD U PSYCHOL LABS LIB
1 U OF ILL LIB SER DEPT
2 U OF KANSAS LIB PERIODICAL DEPT
1 U OF NEBRASKA LIBS ACQ DEPT
1 OHIO STATE U LIBS GIFT + EXCH DIV
1 PENNA STATE U PATTEE LIB DOCU DESK
1 PURDUE U LIBS PERIODICALS CHECKING FILES
1 STANFORD U LIBS DOCU LIB
1 LIBN U OF TEXAS
1 SYRACUSE U LIB SER DIV
1 U OF MINNESOTA LIB
1 STATE U OF IOWA LIBS SER ACQ
1 NO CAROLINA STATE COLL DH HILL LIB
2 BOSTON U LIBS ACQ DIV
1 U OF MICH LIBS SER DIV
1 BROWN U LIB
2 COLUMBIA U LIBS DOCU ACQ
1 DIR JOINT U LIBS NASHVILLE
1 U OF DENVER MARY REED LIB
2 DIR U LIB GEO WASHINGTON U
2 LIB OF CONGRESS CHF OF EXCH + GIFT DIV
1 U OF PGH DOCU LIBN
1 OFC OF DIR CATHOLIC U LIB ATTN PSYCHOL DEPT LIB
1 U OF KY MARGARET I KING LIB
1 SO ILL U ATTN LIBN SER DEPT
1 KANSAS STATE U FARRELL LIB
1 BRIGHAM YOUNG U LIB SER SECT
1 CALIF HEALTH + WELFARE AGY MENDOCINO STATE HOSP ATTN C A BROWNFIELD
1 DEPT OF PSYCHOL WAKE FOREST COLL ATTN DR JACK N HICKS
1 THE BOEING CO SEATTLE ATTN DR CONRAD KRAFT
1 CORNELL AERONAUTICAL LAB BUFFALO ATTN DR RICHARD MONTY
1 SYS DEVEL CORP SANTA MONICA ATTN DR DONALD MURPHY
1 NATL NAVAL MED CTR NAVAL MED RES INST BETHESDA ATTN DR THOMAS I MYERS
1 UNIT EXPRN PSYCHIATRY U OF PENNSYLVANIA PHILA ATTN DR MARTIN ORNE
1 SR MED INVESTIGATOR VA HOSP OKLAHOMA CITY ATTN DR JAY T SHURLEY
1 NATL NAVAL MED CTR NAVAL MED RES INST BETHESDA ATTN DR SEWARD SMITH
1 DEPT OF PSYCHOL LONG BEACH STATE COLL ATTN DR ROBERT E THAYER
1 DEPT OF PSYCHOL PRINCETON U ATTN PROF JACK VERNON